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International Comparison of
Production Structures
Between Taiwan and Japan

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Chapter I

Introduction

I.1. The Scope of the Present Study

Since the 1950's when most of the present third world countries achieved their independence, they have been searching for a magical way to develop their economies with the hope that one day, they will be able to bridge the material gaps between their economies and the developed ones. Naturally they looked for a theory, or some sort of generalizations which would show them the way to achieve their goals. The past experience in the development of the advanced countries as well as the developing ones constituted a good reference to them. In this thesis, we attempt to make an international comparison between two Asian economies, Japan and Taiwan, concerning some of their development situations in the recent years of 1960-1970. However, our goal will not be too ambitious and our major attention will only be placed on their production structures.

The two concerned economies represent two different stages of economic development in Asia, yet both of them give remarkable performance in the world of economic race.

The success of economic development of Japan is quite familiar to us as it is by any measure, an advanced country. It has therefore often become the object of much economic researches.

Japan is not only an advanced industrialized country in the Eastern scope of the world, its achievement by far has outrun many other Western countries. Many industries of Japan, for example, steel, shipbuilding, automobiles and electrical appliance rank on the top of the world even though Japan lacks many resources.

Apart from Russia, Japan is sharing the same rank with America and Western Germany. Together they are understood to be three giants in the economic world. Of these three giants, Japan was selected to be the object of comparison to another Southern Asia country. The reasons are obvious. The geographical environment, the ancestral stream, history, culture, customs and traditions of Japan and other countries in the Southeast Asia region are quite similar. What is more is that all these countries are lacking in natural resources which are vital for economic development. However, the fact that Japan is able to reach a high standard of economic achievement after the Meiji Restoration certainly indicates the potential of Japan to become the economic model of other countries in the region.

The economic development of Taiwan in the recent ten years has also been eye-catching. Apart from Japan, Taiwan's GNP growth rate and GNP per capita growth rate

are much higher than those of the other countries in the region.¹ Total GNP at constant price grew at the average rate of 9.6% during 1961-70 and per capita GNP at the rate of 6.7%. Its increase in the share of industrial sector is also very noticeable at a rate from 19% in 1960 to 25% in 1970 (agriculture at the same time dropped from 32.5 to 19.1% in the respective years) and due to this rapid growth in the industrial sector, unemployment has been brought down to some 2 to 3% since 1960's.

The fact that Taiwan's enormous achievement occurs after the termination of the American aids is very striking.² Also, Taiwan has to shoulder two extra burdens during the course of development, namely, the mounting defence expenditure and the rapid increase in population. The former is peculiar for an developing economy where total government

¹See, United Nation Statistical Year Book, many issues.

²The development of Taiwan was certainly affected by the American aids and also by the construction built during its reign under Japan. Japanese lafacy has left a very good agricultural base such that after the war, Taiwan is able to produce goods and materials more than enough for its industrial requirements. However, Prof. M.H. Hsing had a slightly different point of view as far as the aids are concerned. Please refer to his articles, "A Synthetic Observation on the Economic Growth of Taiwan," in Selected Publication, no. 17 (National Taiwan University, Taiwan, 1971) in Chinese edition.

expenditure absorbed about 20% of the GNP per annum on the average, which is almost unrivalled in the world. The latter was chronic for almost every underdeveloped economy during that period. In spite of the two heavy burdens, Taiwan has progressed exceedingly well in the recent ten years.

This research seeks to see if we can comprehend any findings against the background of Japan and Taiwan, which could also be used as reference to other developing countries in the Southeast Asia region.

I.2. Brief Literature Review

Among the various master pieces of analysis of economic development by quantitative method, the three-sector analysis as presented in The Condition of Economic Progress by Colin Clark is a very distinguished one.³ In his book, industries were grouped into 'Primary, Secondary and Tertiary sectors,' and his main concerns were the distribution and redistribution of labour force among these three sectors. And later Simon Kuznets wrote the "Quantitative Aspects of the Economic Growth of Nations," in which an international comparison was also performed.⁴ Both of the above do not emphasize a precise model form or any strict theoretical framework, however they are fruitful in the exploration of the course of economic development.

³Colin Clark, The Condition of Economic Progress (London : MacMillan and Company, 2nd ed., 1951.)

⁴Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations," in special supplements to regular issues, Economic Development and Cultural Change, including: Levels and Variability of Rates of Growth," Oct., 1956; II. "Industrial Distribution of National Product and Labour Force," July, 1957; III. "Industrial Distribution of Income and Labour Force by States, United States, 1919-21 to 1955," July, 1958; IV. "Distribution of National Income by Factor Shares," April, 1959; V. "Capital Formation Proportion : International Comparisons for Recent Years," July, 1961; VII. "The Share and Structure of Consumption," Jan., 1962.

The Input-Output analysis as propounded by Wassily Leontief was also remarkable. In his celebrated work The Structure of American Economy 1919-1939, he explored the interrelationship among industries in the economy of the United States and he also brought forth a mathematical model of the Walrasian general equilibrium.⁵ The Input-Output scheme, also known as the Leontief system, was further developed by Chenery and Koopmans in a later stage.

In the joint edition by Chenery and Clark, the "Interindustry Economics" and in a paper written by Chenery Watanabe, the Input-Output system was employed to compare the structure of production among four countries: the United States, Japan, Norway and Italy. (Our study in Chapter 3 of Japan and Taiwan follows mainly their line.) The first part of the paper tried to draw an overall picture of the four countries concerned. The method of triangularization of the Input-Output tables are adopted to establish for the four countries a pattern of natural hierarchy of sectors. They try to arrange sectors of each industry in a one-way inter-dependence sequence such as : raw cotton-textiles-clothing. If there were complete interdependence of sectors, then the Input-Output matrix is all filled and the triangular pattern cannot be arranged. But if there exists only one-way dependence of sectors in an economy, the matrix would just have only zeros

⁵Wassily W. Leontief, The Structure of American Economy, 1919-1939, (New York : Oxford University Press, 1951)

on one side of the diagonal. Their findings were that the Processed Foods industry was being placed at the top and the Petroleum industry at the bottom of the consolidated triangle, that means the Food industry, in order to produce its output, purchases a lot from but supplies very little to other sectors, while the Petroleum industry supplies almost all its product as intermediate inputs to other industries. They also find that Japan and USA bear the highest similarity in production structure among all the four countries concerned. In the second part of the paper, in comparing individual industries, the manufacturing is found to be more similar than other sectors for the four countries.

Professor A.O. Hirschman in his The Strategy of Economic Development⁶ pointed out that developing countries are lacking in different kinds of resources required for an all round approach. According to his analysis, the further shortage is the ability to perceive and take investment decisions, even when opportunities arise. The strategy of "unbalancing" some sectors seeks to remedy the shortage by creating pressures for the growth of its complementary parts. He suggests that the initial activity chosen should be one

⁶Albert O. Hirschman, The Strategy of Economic Development, (New Haven : Yale University Press, 1958)

that maximizes the backward and forward linkages. Instead of starting with finished goods, the investments should be made in activities which are near the middle of a triangularly arranged Input-Output matrix. This idea coincides with the proposal of "leading sectors" by W.W. Rostow.⁷ He stated that " In any period of time, the rate of growth in the sectors will vary greatly; and it is possible to isolate empirically certain leading sectors, at early stages of their evolution, whose rapid rate of expansion plays an essential direct and indirect role in maintaining the overall momentum of the economy."⁸

To understand the structure of an economy by identification of its leading sectors is promising. Further understanding can be achieved by the estimation of its production function. In the later part of this thesis, the Cobb-Douglas production function is employed for the cross section estimation of the general production structures of manufacturing sector in Japan and Taiwan.

⁷W.W. Rostow, The Stages of Economic Growth, (Cambridge University Press, 1960)

⁸W.W. Rostow, "Trends in the Allocation of Resources in Secular Growth" in Leon H. Dupriez, ed. Economic Progress, Chapter 15. (Louvain 1955)

Cobb-Douglas production function was well known since its introduction by Professor C.W. Cobb and Professor P.H. Douglas in their "A Theory of Production" in the American Economic Review.⁹

Early studies of production function all used time series data. The data for time series was much easier to obtain, especially that of labour input. But the measurement of capital always involves difficulties. This had once caused the economists to cease their publications. Some of the time series regression studies are presented in table I.1. The results are taken from the famous survey on production functions by A.A. Walters¹⁰ in which a very thorough discussion of the theoretical background (especially those related to econometric problems of identification and specification of production function) and a comprehensive survey on the empirical work are given. As Walters pointed out, most of the studies have only very simple specification or have completely neglected the specification problem, they cannot be treated as very successful although their results conform with unity sum of

⁹C.W. Cobb and P.H. Douglas, "A Theory of Production," American Economic Review Vol. 18, Supplement, (1928) pp.139-165.

¹⁰A.A. Walters, "Production and Cost Functions : An Econometric Survey," Econometrica Vol. 31, (1963) pp. 1-66.

coefficients and the labour exponent is close to the share wages in the value of output.

The first cross section study on production function was presented by Bronfenbrenner and Douglas in 1939.¹¹ Later cross section of inter-firm, inter-industry, inter-state and inter-country studies were carried out for many industries and countries. The evidence for constant return is strong except one study by Klein on rail-road industries of US which revealed increasing return.¹² Another exception was the study on Indian industry by Murti and Sastry in which the finding for coal industry showed 1.15 in 1951 and 1952.¹³

¹¹M. Bronfenbrenner and P.H. Douglas : "Cross section Studies in the Cobb-Douglas Function," Journal of Political Economy Vol.47 (1939), pp.761-785.

¹²I.R. Klein, A Textbook of Econometrics (Evanston 1953)

¹³V.N. Murti and U.K. Sastry : "Production Functions for Indian Industry," Econometrica, Vol.25 (1957), pp.205-221.

Table I.1 Former Time-Series Studies on Cobb-Douglas Production Function

<u>Period</u>	<u>Country</u>	<u>α</u>	<u>β</u>	<u>$\alpha + \beta$</u>	<u>Reference</u>
1899-1922	U.S.A.	0.81	0.23	1.04)	Douglas (1948) ¹⁴
		0.78	0.15	0.93)	
		0.73	0.25	0.98)	
1909-1949	U.S.A.	0.65	0.35	restricted	Solow (1957) ¹⁵
1900-1955	Norway	0.76	0.20	0.96	Aukrust & Bjerke (1959) ¹⁶
1909-1949	U.S.A.	0.99	0.23	1.22	Walters (1962) ¹⁷

¹⁴P.H. Douglas, "Are there Laws of Production?"
American Economic Review, Vol.38 (1948), pp.1-41.

¹⁵R.M. Solow, "Technical Change and the Aggregate Production Function," Review of Economics & Statistics, Vol.39 (1957), pp.312-320.

¹⁶A.A. Walters, "Economies of Scale in the Aggregate Production Function" Discussion paper A29, University of Birmingham, 1962.

¹⁷O. Aukrust and J. Bjerke, "Real Capital & Economic Growth in Norway 1900-56" Income & Wealth Series VIII, 1959.

Some of the results of former cross-section studies taken from the survey by Walters are presented below :

Table I. 2 Former Cross-section Studies on Cobb-Douglas Production Function

<u>Year</u>	<u>Country</u>	<u>α</u>	<u>β</u>	<u>Materials</u>	<u>Sum of Exponents</u>	<u>Reference</u>
1936	U.S.A. Railroads	0.89	0.12	0.28	1.29	Klein (1953) ¹⁸
1909	U.S.A. Clothing Food Metal & Machinery	0.98 0.72 0.71	0.07 0.35 0.26		0.91 1.07 0.97 }	Bronfenbrenner ¹⁹ and Douglas
1919	U.S.A.	0.76	0.25		1.01	Douglas (1948) ²⁰
1951	India Coal	0.59 0.71	0.40 0.44		0.99 1.15 }	Murti and Sastry (1957) ²¹

¹⁸Klein, op.cit

¹⁹Bronfenbrenner and Douglas, op.cit

²⁰Douglas, op.cit

²¹Murti and Sastry, op.cit

Production functions have been widely discussed in developed countries. However, very few attempts in estimation are made in less developed ones due to the lack of adequate data. The one by Murti and Sastry on Indian becomes a good reference in this respect. Their research was not only focussed on industrial sector as a whole but also on seven individual industries. However, the studies by Murti and Sastry and many other cross-section estimations employed monetary values of outputs and capital inputs (sometimes even labour inputs) as observations. The results obtained may not fully reflect the real production function but just some sort of average of production structure.

In the studies of the Input-Output structure and production functions of Japan and Taiwan, our interest is also placed on their patterns of growth and development. With regard to the comparison of development patterns, it is worthwhile to mention the significant contribution of Chenery and Watanabe.²² In their article, "International Comparison of the Production Structure," they introduced many comparison methods based on Input-Output structure which are very useful.

²²Hollis B. Chenery and Tsunehiko Watanabe, "International Comparisons of the Structure of Production," Econometrica, (Oct., 1958) pp. 487-521.

Later, Chenery and Taylor estimated inter-country growth patterns for major sectors and country groups.²³ Their major conclusion is that three distinct development patterns can be identified : large countries, small primary-oriented countries and small industry-oriented countries.

Finally, there are two studies on Japan and Taiwan which are noticeable : examination of the growth of Japan by Chenery, Shishido and Watanabe²⁴ and studies in the growth and employment of Taiwan and Korea by Fei and Ranis.²⁵ They are good reference for researches although the former was done by means of Input-Output analysis while the latter was by means of comparative static macro-economic model.

²³Hollis B.Chenery and Lance Taylor, "Development Patterns : Among Countries and Over Time," The Review of Economics and Statistics, Vol. 50, (Nov., 1968) , pp. 391-416.

²⁴H.B. Chenery, S. Shishido and T. Watanabe, "The Pattern of Japanese Growth, 1914-1954," Econometrica, Vol. 30 (Jan., 1962), pp.98-137.

²⁵C.H. Fei and G. Ranis, "A Model of Growth and Employment in Open Dualistic Economy : The Case of Korea and Taiwan," Journal of Development Studies, (Jan., 1975), pp.33-63.

I.3 Contents

In the following chapters, we will attempt to compare the production structures between Japan and Taiwan from several viewpoints. All of them will emphasize on the supply condition of the production process only. We would particularly place more importance on the use of labour, capital and intermediate inputs and the depreciation structure in production.

A discussion on the simple theoretical background will be put forward in the immediate chapter i.e. Chapter 2. In this Chapter, we hope to explain the methodology that we use and give some brief notes on the theoretical problems that may be evolved.

We have conglomerated two very familiar production models as the bases of the following analysis. One is the Leontief's Input-Output production system and the other is the Cobb-Douglas production function. With these two models put together, we specify the usual hypothesis of fixed coefficients for intermediate deliveries and the import structures, but keeping the assumption of substitution between capital and labour inputs in the Cobb-Douglas version.²⁶

²⁶The use of two production functions at the same time was once adopted by Lief Johansen in his A Multisectoral Economic Growth (Amsterdam : North Holland Pub. Co., 1964)

With the help of some formulations and data of 4 Input-Output tables of Taiwan and 3 Input-Output tables of Japan, we will try to give a review on the following problems :

1. Is there any similarity and difference in the production structures between Japan and Taiwan ?
2. Does Taiwan need to follow Japan's pattern of production in its development ?
3. Are there any trends in Taiwan or other underdeveloped countries that need our attention ? For example, which one should a developing country follows, capital-intensive or labour-intensive production ?
4. Is there any particular industries which are worthwhile for more development ?

Based on these studies, we hope reference can be drawn for the developing countries which are also sited in the same area.

In Chapter 3, we will adopt some simple measures from Chenery and Watanabe for the comparison of the utilization of intermediate inputs, the dependence on imported inputs and the depreciation of capital between the two concerned countries. After an aggregation process of the original Input-Output tables of some 76 sectors of Taiwan and 56 sectors of Japan, 23 industries are being compared.

In this Chapter 3, Japan and Taiwan are found slightly different in their utilization of intermediate inputs. If we follow the line of Chenery and Watanabe, that is the higher the rate of the use of intermediate inputs the higher the degree of production roundaboutness, then Japan is evidently more advanced than Taiwan in terms of using more intermediate deliveries from other industries for each of their industries. Japan's use of intermediate input per unit of output averages to 54% while that for Taiwan is 48% in the year of 1970. Further, with the use of this Input-Output ratios, we will divide the industries of Japan and Taiwan into four categories. Other things being equal, we can identify individual industry or group of industries whose expansion may lead to further development of other industries in terms of forward and backward linkage effects.

Basically, both Japan and Taiwan are lack of resources. The import of goods into the two economies is enormous while the import of raw materials and intermediate-parts required in production worth much attention. In section 3 of Chapter 3, we make a comparison on the requirements of imported intermediate inputs between the two economies and find that Taiwan has imported more than Japan. The average rate of imported inputs per unit of output in Taiwan is 12% and in Japan is only 7%. That is to say, for each 100 dollars

of output of Taiwan there is 12 dollars inputs coming from the rest of the world.

Over time, both economies have increased a lot in the use of imported inputs, especially in such heavy industries as Petroleum, Machinery, Metal and Transportation Equipment industries. This phenomenon, on the one hand, does tell us that both economies have advanced in the race of economic development. On the other hand, it reminds us of their vulnerable situation because of their endowment limpness.

In the final section of Chapter 3, we bring out the depreciation of capital equipments for comparison. Again, we find that Japan and Taiwan differ slightly in this aspect. In general, the depreciation of Japan is faster than that of Taiwan. The depreciation rate of Japan comes approximately to 28% relative to capital expenditure of production, while that of Taiwan is only 19% which later increases to 24%.

The swiftness in the circulation of capital is beneficial in accelerating the economic development. However, such swiftness may not be suitable for Taiwan or other developing countries at its early stage of development where there is little accumulation.

In Chapter 4, we proceed to find out the overall production structures of the manufacturing sector as a whole, instead of industry by industry, by means of a simple regression

estimation of the Cobb-Douglas production function. Values of labour, capital and output of 56 industries of Taiwan for each of the 4 years from 1964 to 1971 (40 industries only for the year 1964) and 42 industries of Japan for each of the 3 years from 1960 to 1970 are taken as observations to fit the simple regression equation :

$$\ln Px = \ln A^* + \alpha^* \ln wL + \beta^* \ln rK + u$$

where Px = production value (value added)

wL = labour wage bill

rK = capital outlay

A^* = residual technical parameter

α^* = output elasticity with respect to labour wage bill

β^* = output elasticity with respect to capital outlay²⁷

u = stochastic disturbance

Results obtained are satisfactory and the 7 cross-section equations are shown in Chapter 4.

However, as our data on labour, capital and output are all measured in monetary terms rather than in physical terms, the output elasticities may not be interpreted in a direct way. The labour and capital coefficients obtained are

²⁷A star is put to distinguish from the ordinary output elasticities of Cobb-Douglas production function.

some multiples of the "ordinary" output elasticities time their respective market structure elasticities. In symbol form they are

$$\alpha^* = \frac{\alpha}{1 + \epsilon_L} \quad \beta^* = \frac{\beta}{1 + \epsilon_K}$$

where α and β are the "ordinary" output elasticities with respect to labour and capital in physical measures i.e.

$$\alpha = \frac{\partial X}{\partial L} \frac{L}{X} \quad \beta = \frac{\partial X}{\partial K} \frac{K}{X}$$

and ϵ_L = elasticity of wage rate with respect to quantity of labour,

ϵ_K = elasticity of capital rental rate with respect to the quantity of capital.

As generally expected, the manufacturing sector of Japan is far more capital intensive than that of Taiwan. But there are not much variations over time in the economy of Japan while in Taiwan, a tendency in utilizing more capital in the manufacturing is found.

Much to our surprise, while that parameter A^* , which represents the "catch all" technological state, is fairly stable for Japan over time. For Taiwan, it declines considerably in magnitude. Before further information are obtained, we can hardly say that the technological state of Taiwan has

been degrading since under the estimation by employing data in moneyary terms, not only technical information are included, but price factors are also agglomerated.²⁸

In the final section of Chapter 4, we try the estimation with one more input factor put into the equation such that

$$\ln P_x = \ln A^* + \alpha^* \ln wL + \beta^* \ln rK + \gamma^* \ln M + u$$

where M are the value of imported intermediate inputs.

²⁸ please refer to p. 85 of this thesis.

Chapter II

Theoretical Background and The Data

II.1 The Production Structure

If we specify the usual hypothesis of fixed coefficients for intermediate deliveries but keeping the assumption of substitution of capital for labour, we could then write down the following equations :

- (1) The production function $X_j = A_j L_j^{\alpha_j} K_j^{\beta_j}$ ($j = 1, 2, \dots, n$)
- (2) The intermediate inputs $X_{ij} = a_{ij}(X_j)$ ($j = 1, 2, \dots, n$)
- (3) The imported inputs $M_j = \mu_j X_j$ ($j = 1, 2, \dots, n$)
- (4) Intermediate supply $\sum_i a_{ij} = \sum_i d_{ij} + \mu_j$ ($j = 1, 2, \dots, n$)
- (5) Equilibrium condition $X_j + M_j = F_j + \sum_i X_{ji}$

where X_j : domestic production of sector j

L_j : labour employment in sector j

K_j : capital services in sector j

A_j : state of technology of sector j

X_{ij} : deliveries of intermediate good from sector i sector j

M_j : intermediate imports of sector j

μ_j : import coefficient of sector j

d_{ij} : domestic input coefficients

a_{ij} : intermediate input coefficients

α_j, β_j : scale coefficients with respect to labour and capital inputs

F_j : final demand for the production of sector j

The formulae (1), (2) and (3) together give a complete description of the production structure. Putting them into graphical form we have :

		Sectors				Intermediate Demand	Final Demand	Total Demand
		1	2	3	...n	$\sum_j X_{ij}$	F_i	Z_i
i	1	X_{11}	X_{12}	X_{13}	$\dots n$	$\sum_j X_{1j}$	F_1	Z_1
	2	X_{21}	X_{22}	X_{23}	$\dots n$	$\sum_j X_{2j}$	F_2	Z_2
	3	X_{31}	X_{32}	X_{33}	$\dots n$	$\sum_j X_{3j}$	F_3	Z_3
	n	X_{n1}	X_{n2}	X_{n3}	$\dots X_{nn}$	$\sum_j X_{nj}$	F_n	Z_n
Intermediate Supply								
$\sum_i X_{ij}$								
Total Supply Added V_j	Labour Inputs L_j	L_1	L_2	L_3	$\dots L_n$			
	Capital Inputs K_j	K_1	K_2	K_3	$\dots K_n$			
		V_1	V_2	V_3	$\dots V_n$			
Total Production X_j		X_1	X_2	X_3	$\dots X_n$			
Total Imports M_j		M_1	M_2	M_3	$\dots M_n$			
Total Supply Z_j		Z_1	Z_2	Z_3	$\dots Z_n$			

Within each sector, there is a (relatively invariable) connection between the inputs it draws from other sectors which is basically determined by technology. As displayed in our Input-Output tables and the theoretical framework in Chapter 1, the amounts in the horizontal row of each sector i ($i = 1, 2, \dots, n$) represent deliveries to other sectors as inputs and to F sector as final demands. Final demand can be taken as including the goods and services consigned to investment, current consumption and exports to other countries. On the supply side, each column represents a sector j ($1--n$). In order to produce its product, each sector has to absorb inputs from other sectors, apart from direct inputs of labour and capital. Dependence and independence are the basic characteristics which the Input-Output system can reveal of the production structure of an economy. For instance, for a developing country, the input necessary to produce 100 units of agricultural production may require only a unit of, say, 100 man-years of labour, but for a highly developed country, the input may reflect a larger component of fertilizers, insecticides, tractors and machineries from other sectors.

The more advanced a country is, the more interdependent will be its production sectors. If we let the column total of the Input-Output coefficients of each industry equal to U_j i.e. $U_j = \sum_i a_{ij}$ and the row total equal to W_i i.e. $W_i = \sum_j a_{ij}$, then we have some good measures of the utilisation

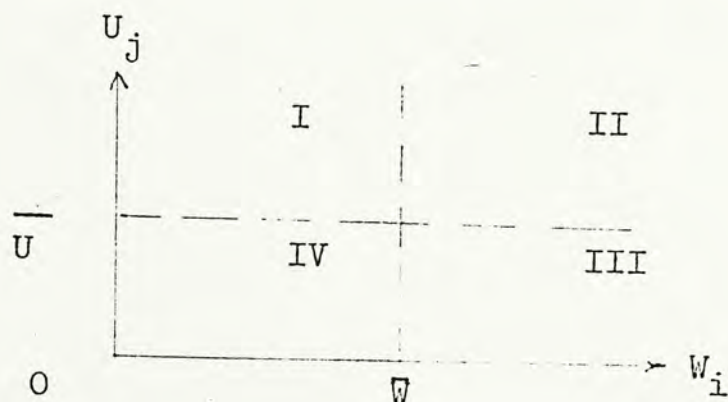
of intermediate inputs and the extent of intermediate demands of each industry. With these values of U_j and W_j , the linkage effects of the industries can also be visualised. It is often understood that when an industry is revolutionized by new technology and undergoes a rapid growth phase, it will eventually promote the development or expansion of the other industries. This inducing power is generally termed the linkage effect. There may be three separable consequences of the rapid growth of such an industry which explains the linkages. Firstly, there is the backward linkage effect. Depending on its technological character, the growing industry will set up requirements for more inputs. These inputs may be materials or machinery. For example, modern cotton textiles stimulated the fabrication of textile machinery and electronic engines. These new induced inputs may be human or a new institutional establishment. The strength of the backward linkage hinges on how much inputs an industry requires from other industries which is in this context is measured by the magnitude of U_j .

The second one is the forward linkage effect. Modern industrial activities created the setting in which new industrial activities were induced, either by cutting the cost of an input to another industry or providing a new product or service whose existence is a challenge to the enterprising to exploit. An industry with strong forward linkage effects thus sets up incentives and opens up possibilities for a wide range of new economic activities, sometimes, even promotes

another leading industry. For instance, railroads are extended into new territories to exploit the new sources of minerals. They, in turn, set in motion long chains of sectoral expansions. How much benefits it gives to other industries or, in other words, the strength of the forward linkage of a certain industry is heavily dependent on how much its output is demanded by other industries.

Finally, a growing industry will induce around itself a whole set of changes which tend to reinforce the industrialization process on a wider front. Modern industrial activities surround themselves with urban people, services, and institutions which strengthen the foundations for further development. This is what is called the lateral effect.

If we plot U_j s and W_i s on a graph paper to find the linkage effects of the industries of an economy, those with high forward and backward linkage effects will surely lie on the upper-right corner and the primitive ones will cater near the origin.



In the above figure, the \bar{U} and \bar{W} are only arbitrarily selected values depending on the nature of the problem concerned.

In what follows, we will turn to the consideration of the equation (1) i.e. the production function.

One of the best instruments for an analysis of production process would be the "production function". A production function is simply a relationship between output and the minimum inputs required. It can also be seen as a quantitative representation of technology and costs.²⁹

Probably the most frequently used kind of production function is the Cobb-Douglas production function.³⁰ Although the function is very specific in its nature, its simplicity in form always gives a lot of convenience in the analysis.

The function is linear in the logarithm of the inputs and outputs :

$$\ln X = \ln A + \alpha \ln L + \beta \ln K$$

Therefore if we measure the logarithms of output and input (all to the same base,) we shall find a linear relationship with a slope of α in the labour axis and a slope of β in

²⁹A.A. Walters, "Production Functions : An Econometric Survey," Econometrica, (Vol. 31 1963) p.1

³⁰C.W. Cobb and P.H. Douglas, "A Theory of Production Function," American Economic Review, (Vol. 18 (Suppl) 1928) pp.139-165

the capital axis. The constant α measures the "elasticity of response" of output to labour inputs. A one per cent increase in labour, with the amount of capital held constant, will add α per cent to output. Similarly, a one per cent increase in the amount of capital, with no change in the labour employed, will add β per cent to the level of output. If both labour and capital are increased by one per cent, the output will expand by $(\alpha + \beta)$ per cent.

$$A(\lambda L)^\alpha (\lambda K)^\beta = AL^\alpha K^\beta \lambda^{\alpha+\beta} = \lambda^{\alpha+\beta} X$$

The coefficients and their sum $(\alpha + \beta)$ have the interpretation in terms of the concept of Production scale as well as in the terms of the concept of convexity. The function is said to be homogeneous to the degree $\alpha + \beta$. If $\alpha + \beta = 1$, the production process is constant return to scale. The original study of Cobb and Douglas in 1928 dealt with manufacturing as a whole in the United States, with annual data from 1899 to 1922. The function obtained was as follows :

$$\ln X = \text{const} + 0.75 \ln L + 0.25 \ln K + u$$

This result has been widely quoted and has been claimed to be of wide applicability. But criticisms arose and most of them were focussed on the highly aggregative nature which conceals a lot of variations in the structure of manufacturing. Later, in its special mathematical form, the marginal rate of

substitution between capital and labour ($= \frac{\alpha K}{\beta L}$) and also the elasticity of substitution is unity is also being queried. These criticisms have been met at least partially by subsequent production function studies, such as the ACMS, CES and VES functions. Although the Cobb-Douglas production function is simple, once we start on the estimation we will encounter a lot of statistical problem. Firstly, there is the classical case of multi-collinearity. As we will aware that the change of one input, say labour, will always lead to the change of another input. One input is the function of another input (or inputs) and the effects of the inputs cannot be fully distinguished.

The second difficulty comes with the problem of aggregation. Many factors considered to be fixed in individual firms may not be so in manufacturing sector as a whole, such as economies of scale. A firm can enjoy larger outputs by expanding its plant, but for an industry, limited supplies of resources on plant-sites will be an obstacle for larger scale. Furthermore the problem of aggregation always relates with the geometric characteristic of the Cobb-Douglas Production while outputs and inputs are added arithmetically. As suggested by Klein in his pioneering paper "Macroeconomies and the Theory of Rational Behavior", to obtain an aggregate production function analogous to the micro ones, the geometrically weighted

variables are necessary.³¹ The economy-wide aggregate production function may be more restrictive, its existence must fulfill very strict conditions of the existence of a social utility function or that the distribution of income are equal among all members of a society.³²

The final and the most vital problem lies with the problem of simultaneity of the production function and its perfectly competitive market condition. The classical ordinary least square estimation of a single equation :

$$\ln X = \ln A + \alpha \ln L + \beta \ln K + u$$

is certainly biased and inconsistent. There exists no simple econometric techniques which can solve the problem. The full system of equation of a production function should be simultaneous as in the following three equations :

$$(\ln X = \ln A + \alpha \ln L + \beta \ln K + u$$

$$(\ln X = \ln(w/p) - \ln \alpha + \ln L + v_1$$

$$(\ln X = \ln(r/p) - \ln \beta + \ln K + v_2$$

where w = wage rate

r = capital rate of return

p = price of output

u, v_1 and v_2 are stochastic disturbances.

³¹L.R. Klein, "Macroeconomics and the Theory of Rational Behavior," Econometrica, Vol. 14 (1946) pp.93-108

³²F.M. Fisher, "The Existence of Aggregate Production Functions," Econometrica, (Oct. 1969) pp.553-557. See also Sato, Production Function and Aggregation, (Amsterdam : North-Holland Pub. Co. 1975) p.283.

There are three "unknown" variables in the system. They are determined by the disturbances and the interaction of the constants, that is by the production coefficients and the relative prices. It is obvious that from the two marginal productivity conditions we can construct an equation which is exactly the same as the production function. This suggests that we need other exogenous variables. This is the basic problem of identification with the system. The first paper stating the problem was by Marschak and Andrews.³³ They suggested "Entrepreneurial ability" to be an exogenous variable. They argued that not all entrepreneur may have the same urge or luck to choose the right way in the process of profit maximisation.

Other economists suggested "fixed inputs" or "capital stock adjustment" to be the exogenous variables. But obviously, the problem has to be solved differently with cross section and time series data. For instance, the capital adjustment is only suitable to time series estimation as the adjustment will be a dynamic process of the productive relationships.

This thesis does not aim to provide clarity to this vagueness nor does it emphasize the problem of statistical

³³J. Marschak and W.H. Andrews, "Random Simultaneous Equations and the Theory of Production," Econometrica . Vol.12 (1944) pp.143-205.

accuracy. Instead, it hopes to have some general review of the production structures of Japan and Taiwan during these recent few years. Therefore, the above problems will be assumed to be non-existent in this thesis and estimation of the equations will be performed by simple least square estimation.

Furthermore, because of limited data, we use dollar values as measures of outputs and inputs rather than physical values. However, a production function basically should not consist of "economic" values such as prices, interests, wages, and market variables which provide inducement for the diversion of resources, or expressions of equilibrium situation in the economic world. It is however extremely difficult to construct such a function without including some economic magnitudes. "Engineers may articulate the relations between outputs and inputs in physical dimensions, yet they may have pre-selected the set of technical alternatives on the basis of relative factor costs. And in so doing, economic variables creep into the production function.³⁴ Thus, a production function of pure engineering data may be impossible to obtain. The derivatives of production function using monetary values of inputs and outputs in the Cobb-Douglas version is a little different from the usual one.

³⁴W.E.G. Salter, Productivity and Technical Changes, Cambridge University Press, 1961.

Firstly we have,

Demand function of outputs $X = b'_x P^{\xi_x}$ or $P = \left(\frac{X}{b'_x} \right)^{\frac{1}{\xi_x}}$

Supply function of labour inputs $L = b'_L W^{\xi_L}$

Supply function of capital inputs $K = b'_K r^{\xi_K}$

where b'_x , b'_L and b'_K are constants and ξ_x , ξ_L and ξ_K are elasticity of demand for output, elasticity of supply of labour and elasticity of supply of capital respectively.

The total revenue from sales is

$$PX = \frac{X^{\frac{1}{\xi_x}}}{b'_x^{\frac{1}{\xi_x}}} \cdot X = b_x X^{\eta_x}$$

and the outlays on labour and capital are :

$$\omega L = \frac{L^{\frac{1}{\xi_L}}}{b'_L^{\frac{1}{\xi_L}}} \cdot L = b_L L^{\eta_L}$$

$$rK = \frac{K^{\frac{1}{\xi_K}}}{b'_K^{\frac{1}{\xi_K}}} \cdot K = b_K K^{\eta_K}$$

where $b_x = \left(\frac{1}{b'_x} \right)^{\frac{1}{\xi_x}}$ $b_L = \left(\frac{1}{b'_L} \right)^{\frac{1}{\xi_L}}$ $b_K = \left(\frac{1}{b'_K} \right)^{\frac{1}{\xi_K}}$

and $\eta_x = 1 + \frac{1}{\xi_x}$ $\eta_L = 1 + \frac{1}{\xi_L}$ $\eta_K = 1 + \frac{1}{\xi_K}$

With all these revenue from sales, outlays on labour and capital put into the Cobb-Douglas form, we have :

$$\left(\frac{PX}{b_x}\right)^{\eta_x} = A \left(\frac{\omega L}{b_L}\right)^{\alpha \frac{\eta_x}{\eta_L}} \left(\frac{rK}{b_K}\right)^{\beta \frac{\eta_x}{\eta_K}}$$

$$PX = \frac{A^{\eta_x} b_x}{b_L^{\alpha \frac{\eta_x}{\eta_L}} b_K^{\beta \frac{\eta_x}{\eta_K}}} (\omega L)^{\alpha \frac{\eta_x}{\eta_L}} (rK)^{\beta \frac{\eta_x}{\eta_K}}$$

Taking both sides for logs,

$$(1) \quad \ln PX = \ln A^* + \alpha^* \ln(\omega L) + \beta^* \ln(rK)$$

where

$$A^* = \frac{A^{\eta_x} b_x}{b_L^{\alpha \frac{\eta_x}{\eta_L}} b_K^{\beta \frac{\eta_x}{\eta_K}}} \quad \alpha^* = \alpha \frac{\eta_x}{\eta_L} \quad \beta^* = \beta \frac{\eta_x}{\eta_K}$$

Thus, regression on equation (1) will result in some specific parameters which include respective elasticities of supply of inputs and elasticities of demand for outputs.³⁵

³⁵ Marc Nerlove, Estimation and Identification of the Cobb-Douglas Production Function, (Amsterdam : Publishing Co., 1965) North-Holland.

II.2 The Data to be employed in this study

The major statistics used in this study are Input-Output tables of Japan and Taiwan. The tables of Japan are compiled by Trade and Export Department of the Government of Japan (translated from Japanese,) while that of Taiwan are compiled by the Overall Planning Department of Economic Planning Council of the Executive Yuan of Taiwan. Those for Japan are of the years 1960, '65 and '70 while for Taiwan are of the years 1964, '66, '69 and '71, all of them at current market price in local currencies. They represent some ex-post accounting of production output and the constituent intermediate inputs, imported inputs, labour wage bills and capital expenditures. Labour wage bills are predominately wages, salaries and compensation for employees, and expenditures on capital are predominately rent, interest profits, taxes(which are parts of the profits before they are excised) and depreciations. The above mentioned items make up for the total supply side of an Input-Output table. Also there are items on the demand side which, however, have not been employed in this study.

The construction of the Input-Output tables of both Japan and Taiwan are heavily based on the American experience with the Open-Leontief Framework. The components of imported inputs are all measured at c.i.f. prices. Although different currency units are used in the tables for the two economies,

they will not be very interfering as we will deal with relative magnitudes in most part of the study.

Tables of Japan and Taiwan are different in dimensions. For the sake of international comparison without arousing confusions, particularly in the discussion in Chapter 3, the tables are arranged to have the same 23 sectors, so that the classification of sectors for both countries corresponds to each other.

The classification of these 23 sectors is approximately in accordance with the International Standard Industrial Classification (ISIC) to the 2-digit level. They are :

- | | |
|---------------------------|------------------------------------|
| 1. Agriculture | 13. Chemistry |
| 2. Forestry | 14. Non-metal product |
| 3. Fisheries | 15. Metal product |
| 4. Mining | 16. Machinery |
| 5. Coal & product | 17. Miscellaneous Manufacturing |
| 6. Petroleum & product | 18. Construction |
| 7. Food Manufacturing | 19. Communication & Transportation |
| 8. Textiles | 20. Transport Equipment |
| 9. Wood & product | 21. Power & Water |
| 10. Printing & Publishing | 22. Trade |
| 11. Leather & product | 23. Services |
| 12. Rubber & product | |

The Intermediate Inputs Structure

III.1 Introduction

In this chapter, we attempt to compare the difference or similarity in the interdependence of the production structure between Japan and Taiwan in terms of the extent to which they utilize the intermediate inputs. According to Chenery and Watanabe, "primary" sector referred to industries of high value added (V_j), and manufacture to industries which make more use of indirect inputs, $\sum a_{ij}$, or in other words, a more roundabout production method.³⁶ Primary sector, as the example of agriculture production given above, usually employs barely the direct inputs i.e. labour and capital, and in less developed countries a great portion of labour.³⁷ The manufacture sector, or the so-called industrial sector, mainly consists of those chemical, machinery, iron and steel or even textiles industries, demands quite a lot of indirect inputs from other sectors which may be agricultural inputs or services of the industrial sector itself. The production of each unit of output from the "manufacture" sector would require only a small amount of direct labour and capital but a large amount indirectly through the production of other sectors.

With this basic concepts, we try to give in the subsequent sections a review on the utilization of the intermediate inputs of the two countries concerned.

³⁶Chenery and Watanabe, op. cit. p.492

³⁷in this case, land may be categorized into capital

III.2 Comparison of the use of Intermediate Inputs

The results of the comparison of the utilization of intermediate inputs between Japan and Taiwan are presented in Table 3.1 and 3.2. In the few years under study, the difference between the use of intermediate inputs in Japan and Taiwan is understood to be not very significant. The mean value of the extent in the use of indirect inputs is about 50%. For Japan, the average is 53-54% while for Taiwan 48-52%.

a_{ij} , input/output ratio, may cause a little confusion here. One way to interpret it is that the lower the value of a_{ij} , the more efficient would be its production since less materials are required. But our major concern is the value of the summation of the purchases of inputs from 1 to n of an individual industry j i.e. $\sum_i a_{ij}$, which is an indication of interindustry interdependence. That is to say, the higher the value of $\sum_i a_{ij}$, the more complicated is the process of production. During the years 1960-70, the value added (V_j) of nine sectors : Agriculture, Forestry, Fishery, Mining, Construction, Transportation, Power, Trade and Services of both Taiwan and Japan was large, while their $\sum_i a_{ij}$ were small. These so-called primary sectors as identified in both Taiwan and Japan were almost the same. This indicated that the basic structures of the economies of Japan and Taiwan are similar with high value added in primary and tertiary production and low value added in manufactures.

Such classification and terminology of sectors was first introduced by Colin Clark in his Conditions of Economic Progress. In his book, primary sector referred to the Agriculture and Mining industries; secondary sector referred to all Manufacturing industries, or in another term, the industrial sector, and finally the tertiary sector consisted of mainly the Service industries. He further suggested that the economic development of any economy naturally follows a pattern. In a step by step way, the tertiary and secondary follow after the development of the primary sector.

In Table 3.2, the values of γ_j^{J-T} indicate the similarity of and difference between Japan and Taiwan in the utilization of intermediate inputs for industry. The calculation of γ_j^{J-T} is very simple, and is similar to the absolute column measure proposed by Chenery and Watanabe.³⁸

$$\gamma_j^{J-T} = \frac{|\sum_i a_{ij}^J - \sum_i a_{ij}^T|}{\frac{1}{2}(\sum_i a_{ij}^J + \sum_i a_{ij}^T)}$$

where T refers to Taiwan and J refers to Japan.

³⁸Chenery and Watanabe, op. cit. p.505. The measure they had introduced were $\gamma_j^{J-T} = \frac{\sum_i |a_{ij}^J - a_{ij}^T|}{\sum_i (a_{ij}^J + a_{ij}^T)}$ but the meaning is very similar to that of ours. The measurement of γ_j^{J-T} would have the value between 0 and 2.

The value of γ_j^{J-T} will lie between 0 and 2. Zero refers to the case where the industry bear the highest level of resemblance between the two countries, while 2 refers to the case where they are totally different as far as utilization of intermediate inputs is concerned. Among the 23 sectors, the value of 19 of them is below 0.50 in 1965-70.

The values of γ_j^{J-T} of 8 sectors, including Petroleum and product, Food Manufacturing, Textiles, Wood and product, Chemicals, Non-metal and product and Construction are below 0.10. Therefore the technology for these 8 industries bear the highest degree of similarity between Japan and Taiwan.

Table III.1

Intermediate Input Coefficients of Taiwan and Japan

(values of $\sum a_{ij}$)

	<u>Taiwan</u>		<u>Japan</u>	
	<u>1966</u>	<u>1971</u>	<u>1965</u>	<u>1970</u>
Agriculture	0.42	0.49	0.33	0.36
Forestry	0.10	0.10	0.45	0.47
Fishery	0.42	0.40	0.30	0.27
Mining	0.16	0.13	0.36	0.33
Coal	0.32	0.30	0.63	0.78
Petroleum	0.47	0.44	0.48	0.49
Food	0.66	0.73	0.74	0.72
Textiles	0.78	0.76	0.75	0.73
Wood	0.77	0.74	0.74	0.72
Printing	0.68	0.55	0.50	0.51
Leather	0.64	0.54	0.76	0.72
Rubber	0.76	0.52	0.66	0.64
Chemicals	0.73	0.59	0.60	0.65
Non-metals	0.52	0.54	0.55	0.59
Metals	0.76	0.74	0.76	0.74
Machinery	0.72	0.60	0.61	0.64
Miscellaneous	0.71	0.53	0.65	0.64
Construction	0.61	0.67	0.63	0.62
Communication & Transportation	0.41	0.35	0.30	0.30
Transportation				
Equipment	0.76	0.63	0.66	0.66
Power	0.45	0.42	0.32	0.34
Trade	0.11	0.20	0.26	0.29
Services	0.12	0.12	0.21	0.28

Table III.2

Similarity in production (the use of intermediate inputs)
 (values of γ_j^{J-T})

	<u>1965</u>	<u>1970</u>
Agriculture	0.23	0.31
Forestry	1.27	1.29
Fishery	0.33	0.39
Mining	0.75	0.85
Coal	0.67	0.88
Petroleum	0.03	0.10
Food	0.12	0.02
Textiles	0.03	0.04
Wood	0.04	0.03
Printing	0.30	0.06
Leather	0.18	0.29
Rubber	0.13	0.21
Chemicals	0.19	0.09
Non-metals	0.06	0.09
Metals	0.0017	0.0007
Machinery	0.16	0.06
Miscellaneous	0.09	0.18
Construction	0.03	0.07
Communication & Transportation	0.30	0.14
Transportation Equipment	0.14	0.04
Power	0.34	0.22
Trade	0.88	0.33
Services	0.54	0.77

$$\gamma_j^{J-T} = \frac{|\sum_i a_{ij}^J - \sum_i a_{ij}^T|}{\frac{1}{2} (\sum_i a_{ij}^J + \sum_i a_{ij}^T)}$$

III.3 The Leading Industries

It is possible to identify an industry or certain industries which contribute to the development of an economy more than the other industries. It is particular true in the earlier stages when the state of knowledge and experience is much less. There is therefore a tendency to depend on a narrow range of activities at which the country finds itself to be the best at the particular moment of time. The comparative advantage may be traditional or natural, but the main point, however, is that the rapid rate of expansion of these leading industries plays an essential role in maintaining the overall momentum of the economy.

The importance of such industries lies in the fact that it is a powerful essential engine of economic transformation. Its power derives from the multiplicity of its form of impact. When a society is prepared to respond positively to this impact, according to Rostow, growth in such industries tend to raise output per head.³⁹ In terms of the forward and backward linkage effect introduced in Chapter 2, the leading industry on the one hand sets up a chain of effective demand for the manufactured products; sets up requirements for enlarging urban areas; and opens up a range of external economy effects which help to produce new leading sectors when the impulse

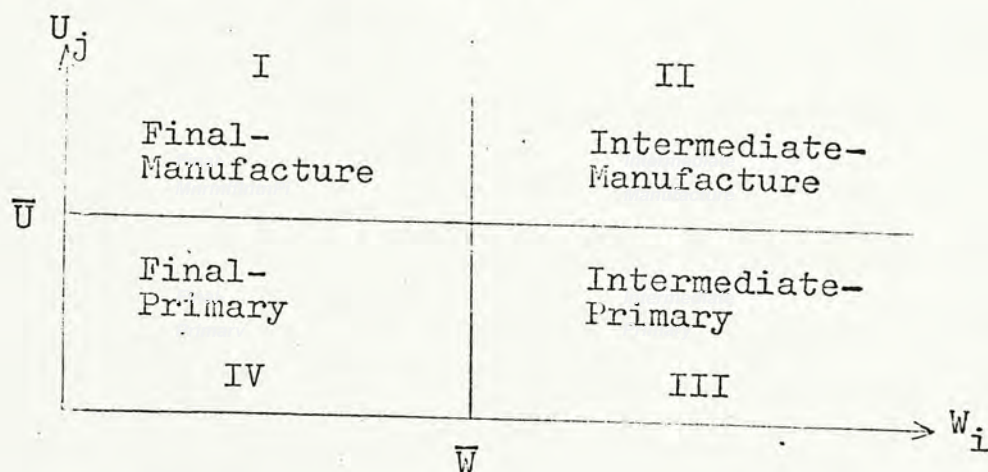
³⁹W.W. Rostow, Stages of Economic Growth (Cambridge University Press 1960)

begins to spread. On the other hand, its supply of product, especially if it is a new product, often proves to be a better stimulus to other industries which require the product as an input than the supply from foreign sources. The reason is obvious since foreign supply usually needs better skill in the process of production and therefore not so stimulating to the local industries. Also importing is subject to balance of payment restrictions and uncertainties.

Based on the statistics of intermediate inputs, we attempt to identify the leading industries of Japan and Taiwan with the intention of sketching a better picture of the production structures of the two economies.

The method we have employed to identify the leading industries heavily draws upon that by Chenery and Watanabe.⁴⁰

Productive sectors for an economy can be divided into 4 categories : (I) Final-Manufacture (II) Intermediate-Manufacture (III) Intermediate-Primary and (IV) Final-Primary as can be shown in the graph below.



⁴⁰Chenery and Watanabe, op.cit., also see Chapter 2 of Chenery and Clark, Interindustry Economics.

High value of U_j means the high utilization of inputs from other industries, in another words, a more roundabout process. It is obvious that if an industry which has high U_j expands, its demand for inputs also increases. Consequently, outputs of other industries will have to expand to cope with the increase in demand. Therefore, high value of it means high backward linkage. High W_i value means the industry supplies many other industries, thus encouraging their expansion. Its importance becomes apparent when it lowers the price of output due to economies of large scale, or as a result of technological improvements, cuts down the costs of inputs of many other industries.

The consolidated results are all presented in the graphs III.1 to III.6. The graphs are drawn with the values of U_j and W_i of the 23 industries of Japan for the years 1960, '65 and '70 and of Taiwan for the years 1966, '69 and '71 respectively. Those graphs which depict the Taiwan industries show a clear pattern which is not very different from that of developing countries. There is heavy concentration in the areas I, III and IV, while area II is sparse. On comparison, the number of industries in Taiwan that cater for final consumers products is greater than that in Japan. It is hardly surprising because Intermediate-Manufacture industries require better skills and greater amount of capital, and this is exactly what the developing countries lack. In the graphs for Japan, the stories told

are quite different. Density in the upper-right corner is much heavier than those in other areas. Most of the industries in Japan are destined for the production of intermediate goods which are supplied to the other industries or exported to the rest of the world. This indicates a circularity characteristic of the Japanese production and also of many developed countries. The results further show that during the few years under study, 7 out of 23 industries (30%) in Taiwan cater for Final-Manufacture products. They are Printing and Publishing, Leather and Rubber products, Miscellaneous Manufacturing products, Machinery, Constructions and Textiles. Taiwan obviously has developed to a stage (as distinguished from very primitive economies) where its production is directed towards the manufacture of industrial consumer goods rather than primary consumer goods such as food and general services. Along with the industrial development process the change in consumption pattern from necessities to consumer goods such as clothings, electrical appliances and miscellaneous products is a widely observed phenomenon prevailing in developing countries in the past and present. These industries all have strong backward linkage effect since their inputs comprise of more than half of the intermediate deliveries from all industries. While in Japan, 5 out of 23 industries (22%) located in area II belong to the Intermediate-Manufacture productions. (It is not surprising that the number of industries in Japan in the

Four Categories of industries of Japan 1970

(I) 7. Food Manufacture

20. Transport Equipment

18. Construction

16. Machinery

17. Miscellaneous

(II). 8. Textiles

11. Leather & Products

9. Wood & Products

15. Metal & Products

5. Coal & Products

12. Rubber & Products

13. Chemicals

14. Non-metal & Products

10. Printing & Publishing

(IV) 22. Trade

23. Services

3. Fishery

(III). 6. Petroleum & Products

2. Forestry

1. Agriculture

21. Power

19. Communication-Transport

4. Mining

Four Categories of Industries of Taiwan 1971

(I) 7. Food Manufacture

18. Construction

20. Transport Equipment

16. Machinery

17. Miscellaneous

10. Printing & Publishing

11. Leather & Products

12. Rubber & Products

(II) 8. Textiles

9. Wood & Products

15. Metal & Products

13. Chemicals

14. Non-metal & Products

(IV) 3. Fishery

19. Communication-Transport

22. Trade

23. Services

(III) 1. Agriculture

6. Petroleum & Products

21. Power

5. Coal & Products

4. Mining

2. Forestry

area II is the same as that in Taiwan. We might find that most of the industries of Japan have larger values of U_j and W_i when compared to that of Taiwan. (the mean of U_j is 0.54 and W_i is 0.72 in 1970) If the U and W of Taiwan are adopted to separate the 4 areas of industries in Japan, there will be 9 industries in the area II.) Industries in this area, on the one hand, require a tremendous amount of intermediate goods from other industries and, on the other hand, supply a great deal of their output to other industries for use as parts, equipments or even as basic materials. Industries on Intermediate-Manufacture maintain high forward and backward linkages that lead to further growth of the economy. Expansions of such industries due to technological advancement, productivity upgrading, economy of scale or discovery of resources will give further spur on the economic activities of the forward- and backward-linking industries. Japan, after many years of effort in the race of economic development, has come up to a stage in which its production process becomes relatively sophisticated. A large part of Japan's industries directs to the production of Intermediate-Manufacturing goods.

According to Chenery and Watanabe, high U_j and W_i values generate stronger backward and forward linkages.⁴¹ It is quite obvious that if there is a leading industry existing in the economy of Japan and in Taiwan, it would definitely come from those industries in the area II.

During the few years under study, the situation has not changed much in the allocation of industries to the 4 areas. only the most prominent one will be pickes out for discussion. In Japan, out of the 5 Intermediate-Manufacturing industries, two of them (the Metal and Product industry and the Wood and Product industry) are very outstanding. These two industries bear the highest value of U_j and W_i and in turn render the highest linkage effects. The Metal industry utilizes an average of 76% of indirect inputs for each unit of production. More than three quarter of its inputs comes from other industries. If the Metal industry expands, then its supplying industries would have to expand also to meet with its requirement of inputs. Of course, there is very high possibility to buy from abroad

⁴¹The interdependence ratios of the Input-Output tables are very rough indexes of the potential linkage effects. A more refined measure of the linkage can be obtained by considering the inverse matrix which enables an estimation of the direct and indirect repercussions of an increase in final demand requirements for any one industry an the other sectors of the economy. This is the so-called "multiplier" effect.

if the local industries cannot cope with the expanding rate, or if the supply is restricted by factor endowment scarcity. With regard to the demand for its products, almost all of its output are relocated to all the other industries with only a negligible amount left for final consumption. The Wood and Product industry is the second most prominent one which still have a U_j of about 0.74 and W_i of about 0.94. The above two industries would most likely generate the greatest impact on the economy of Japan through their expansion and may be termed the "leading" industries of Japan.

In Taiwan, of the 5 Intermediate-Manufacture industries, only one of them is relatively distinguished with a high value of U_j and W_i . The leading industry for Taiwan turns out to be the Metal and Product industry. With the average value of 0.76 and 0.81 of U_j and W_i respectively, the industry can generate more momentum than other industries for further industrialization and its linkage effects directly or indirectly contribute to the greater interdependence of the production system. However, if we recall the import dependent condition of the Metal industry, the above assertion will arouse queries. Of its total Intermediate-Inputs required, 40% is imported. This amount of import is, of course, difficult to be produced locally in Taiwan. That is to say, if the Metal industry is to be developed into the rank of leading industries,

the import of much more intermediate inputs will be necessary. This, however, may give the balance of payment an unfavourable standing, and it may become necessary to export more products in order to gain more foreign currencies.

Another industry that merits our attention is the Agriculture industry in Taiwan. In 1966 and 1969, it is still an industry pertaining to the production of food for final demand. With U_j and W_i both about 0.40, Agriculture in Taiwan belongs to the Primary-Final category. In the early 70's the Agriculture industry has shifted to the Primary-Intermediate group of industries with their output destined for the demand of other industries. The output of the Agriculture industry becomes less as a consumption good but more as an intermediate factor to be utilized for further production in the rest of the economy.

Such transformation clearly signifies that the economy of Taiwan is developing successfully and the usual tendency to look at Agriculture as somewhat backward should be amended.

Table III.3 Intermediate Inputs Supply and Demand of Taiwan

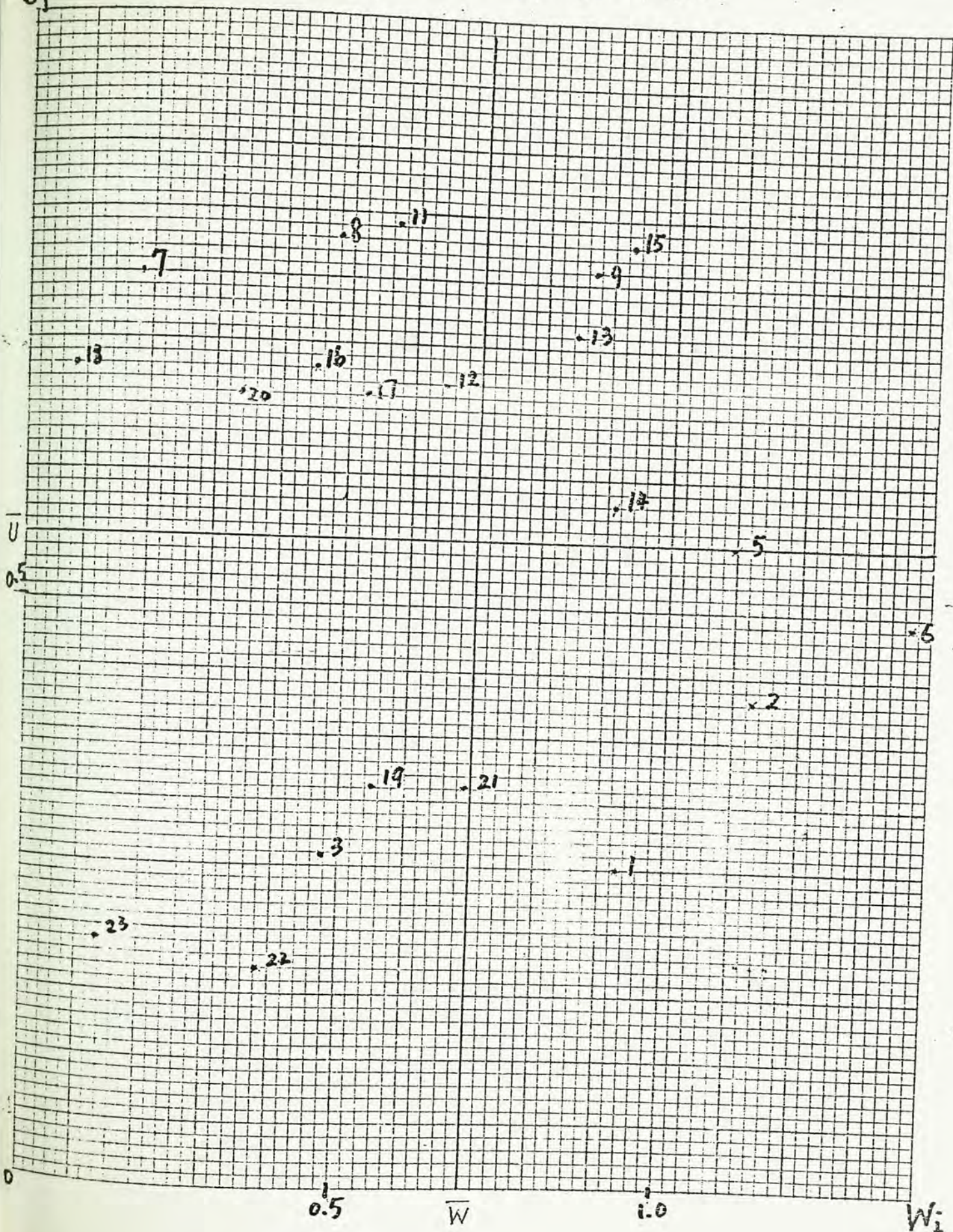
	<u>1966</u>		<u>1969</u>		<u>1971</u>	
	U_i	W_i	U_i	W_i	U_i	W_i
1. Agriculture	0.42	0.42	0.46	0.43	0.49	0.82
2. Forestry	0.10	0.82	0.12	0.92	0.10	0.81
3. Fishery	0.42	0.15	0.42	0.13	0.40	0.14
4. Mining	0.16	0.92	0.27	0.91	0.13	0.95
5. Coal	0.32	0.85	0.36	0.77	0.30	0.83
6. Petroleum	0.47	0.77	0.46	0.77	0.44	0.81
7. Food	0.66	0.21	0.65	0.26	0.73	0.18
8. Textiles	0.78	0.49	0.77	0.47	0.76	0.53
9. Wood	0.77	0.55	0.76	0.55	0.74	0.63
10. Printing	0.68	0.54	0.51	0.35	0.55	0.41
11. Leather	0.64	0.30	0.75	0.33	0.54	0.38
12. Rubber	0.76	0.73	0.72	0.51	0.52	0.37
13. Chemicals	0.73	0.66	0.73	0.66	0.59	0.68
14. Non-metals	0.52	0.54	0.43	0.82	0.54	0.82
15. Metals	0.76	0.78	0.77	0.84	0.74	0.80
16. Machinery	0.72	0.24	0.70	0.18	0.60	0.22
17. Miscellaneous	0.71	0.40	0.70	0.31	0.53	0.29
18. Construction	0.61	0.08	0.61	0.08	0.67	0.08
19. Communication & Transportation	0.41	0.38	0.36	0.43	0.35	0.41
20. Transportation Equipment	0.75	0.20	0.72	0.28	0.63	0.27
21. Power	0.45	0.73	0.44	0.70	0.42	0.68
22. Trade	0.11	0.41	0.13	0.43	0.20	0.36
23. Services	0.12	0.14	0.10	0.13	0.12	0.16
Mean	0.52	0.49	0.52	0.49	0.49	0.51

Table III.4 Intermediate Inputs Supply and Demand of Japan

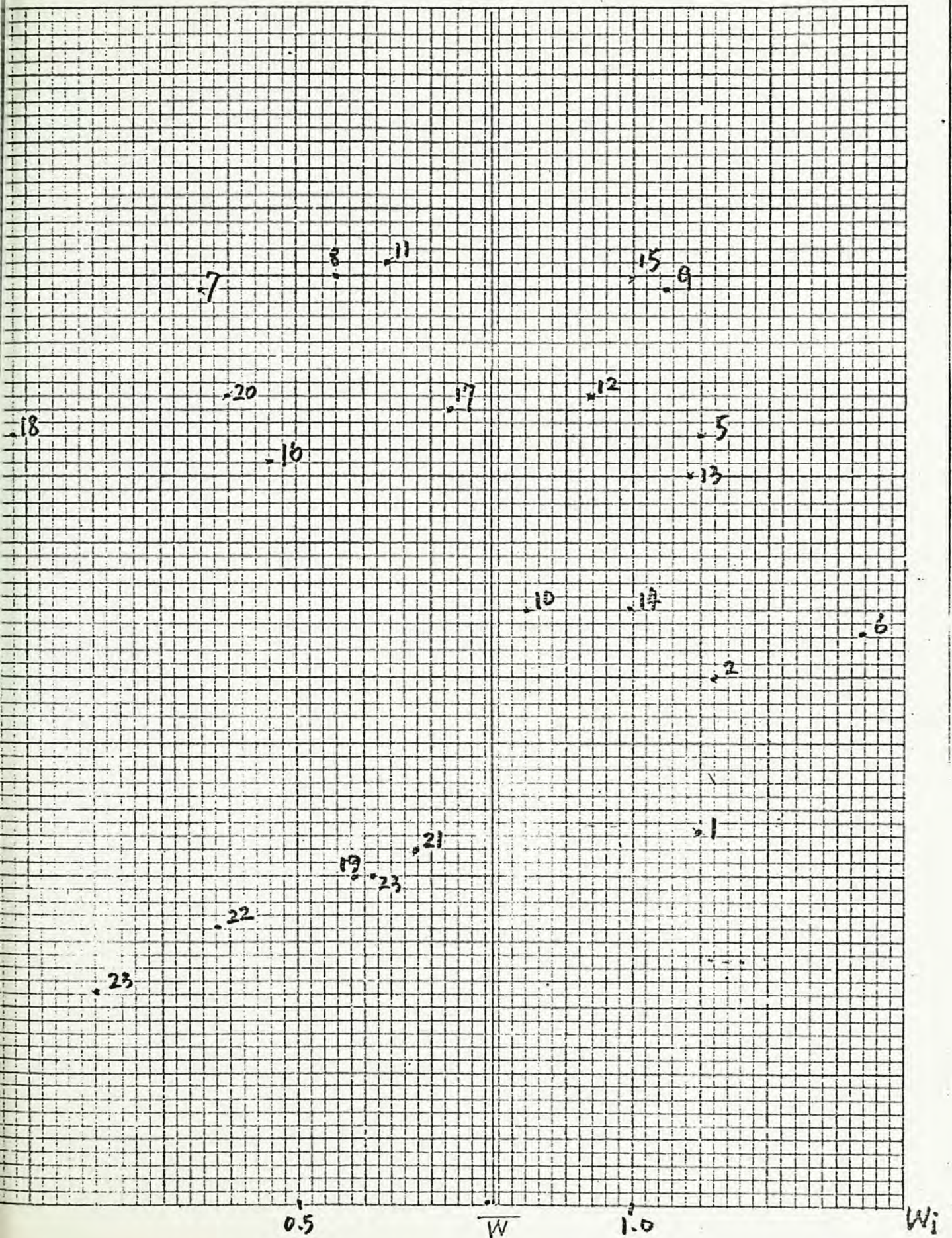
	<u>1960</u>		<u>1965</u>		<u>1970</u>	
	U_i	W_i	U_i	W_i	U_i	W_i
1. Agriculture	0.30	0.93	0.33	1.01	0.36	1.00
2. Forestry	0.43	1.13	0.45	1.13	0.47	1.01
3. Fishery	0.31	0.48	0.30	0.61	0.27	0.43
4. Mining	0.32	1.98	0.36	1.92	0.33	1.99
5. Coal	0.55	1.11	0.63	1.11	0.78	1.08
6. Petroleum	0.49	1.37	0.48	1.34	0.49	1.37
7. Food	0.75	0.19	0.74	0.36	0.72	0.20
8. Textiles	0.78	0.49	0.75	0.56	0.72	0.52
9. Wood	0.76	0.88	0.74	1.05	0.72	0.91
10. Printing	0.55	0.67	0.50	0.87	0.51	0.66
11. Leather	0.79	0.57	0.76	0.64	0.72	0.66
12. Rubber	0.67	0.65	0.66	0.95	0.64	0.67
13. Chemicals	0.71	0.85	0.60	1.09	0.65	0.91
14. Non-metals	0.58	0.91	0.55	1.00	0.59	0.91
15. Metals	0.78	0.93	0.75	1.00	0.74	1.00
16. Machinery	0.68	0.45	0.61	0.46	0.64	0.46
17. Miscellaneous	0.66	0.53	0.65	0.73	0.64	0.47
18. Construction	0.68	0.09	0.63	0.08	0.62	0.09
19. Communication & Transportation	0.36	0.55	0.30	0.60	0.30	0.56
20. Transportation Equipment	0.66	0.34	0.66	0.40	0.55	0.38
21. Power	0.36	0.69	0.32	0.68	0.34	0.70
22. Trade	0.22	0.38	0.26	0.39	0.28	0.38
23. Services	0.24	0.14	0.21	0.20	0.27	0.12
Mean	0.55	0.71	0.53	0.79	0.54	0.72

Graph III.1 Industries of Japan - 1960

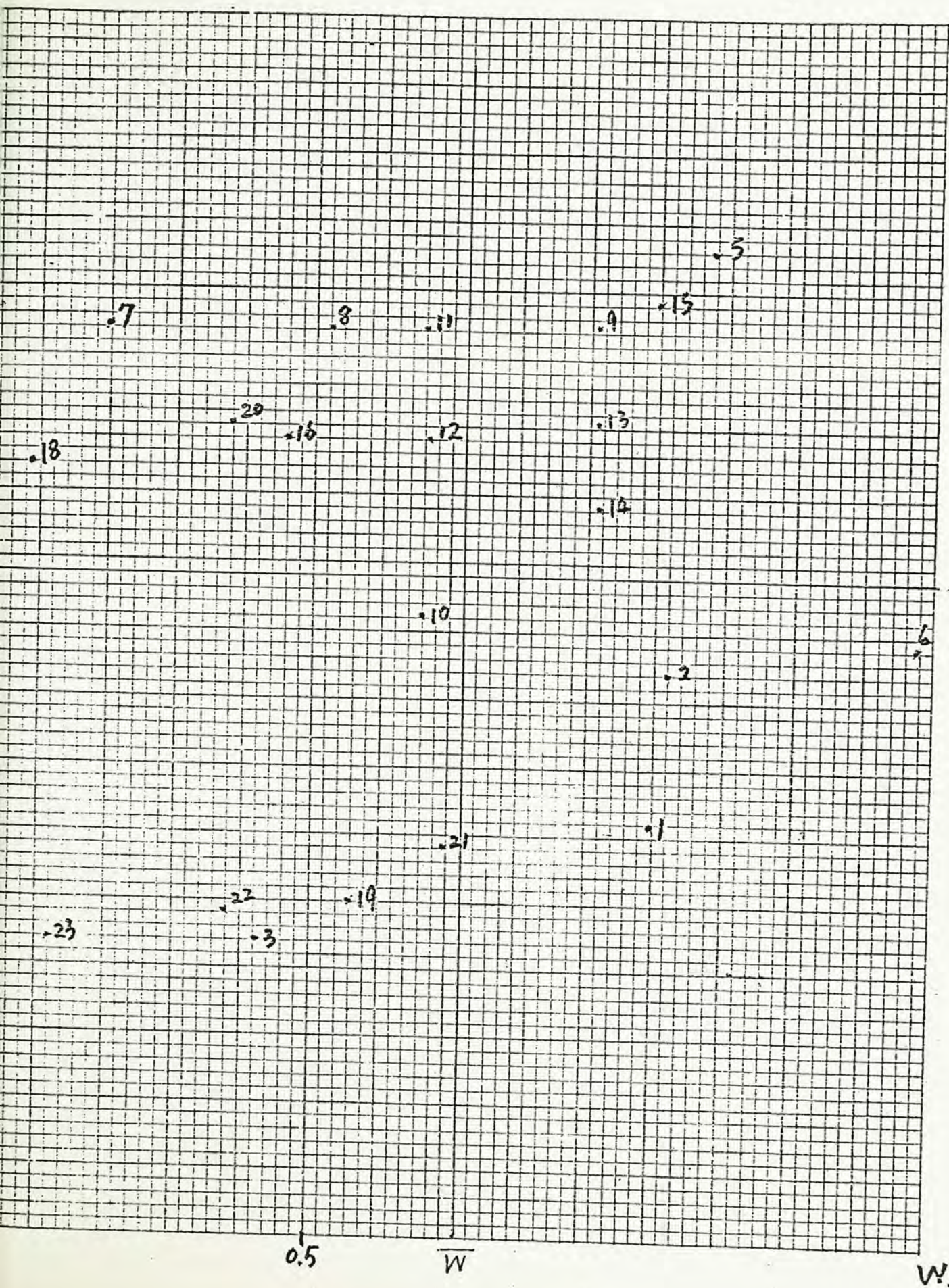
U_j



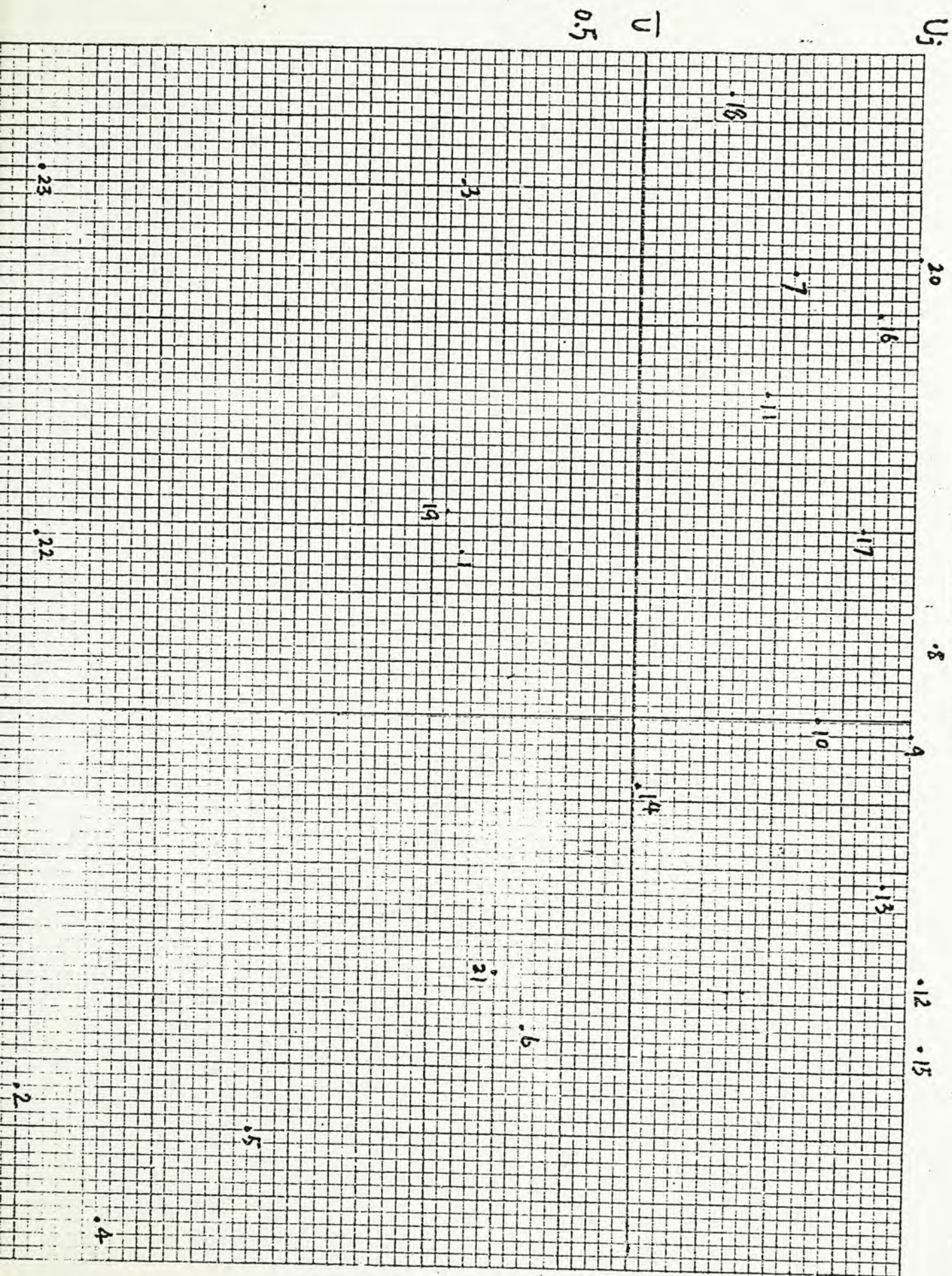
Graph III.2 Industries of Japan - 1965



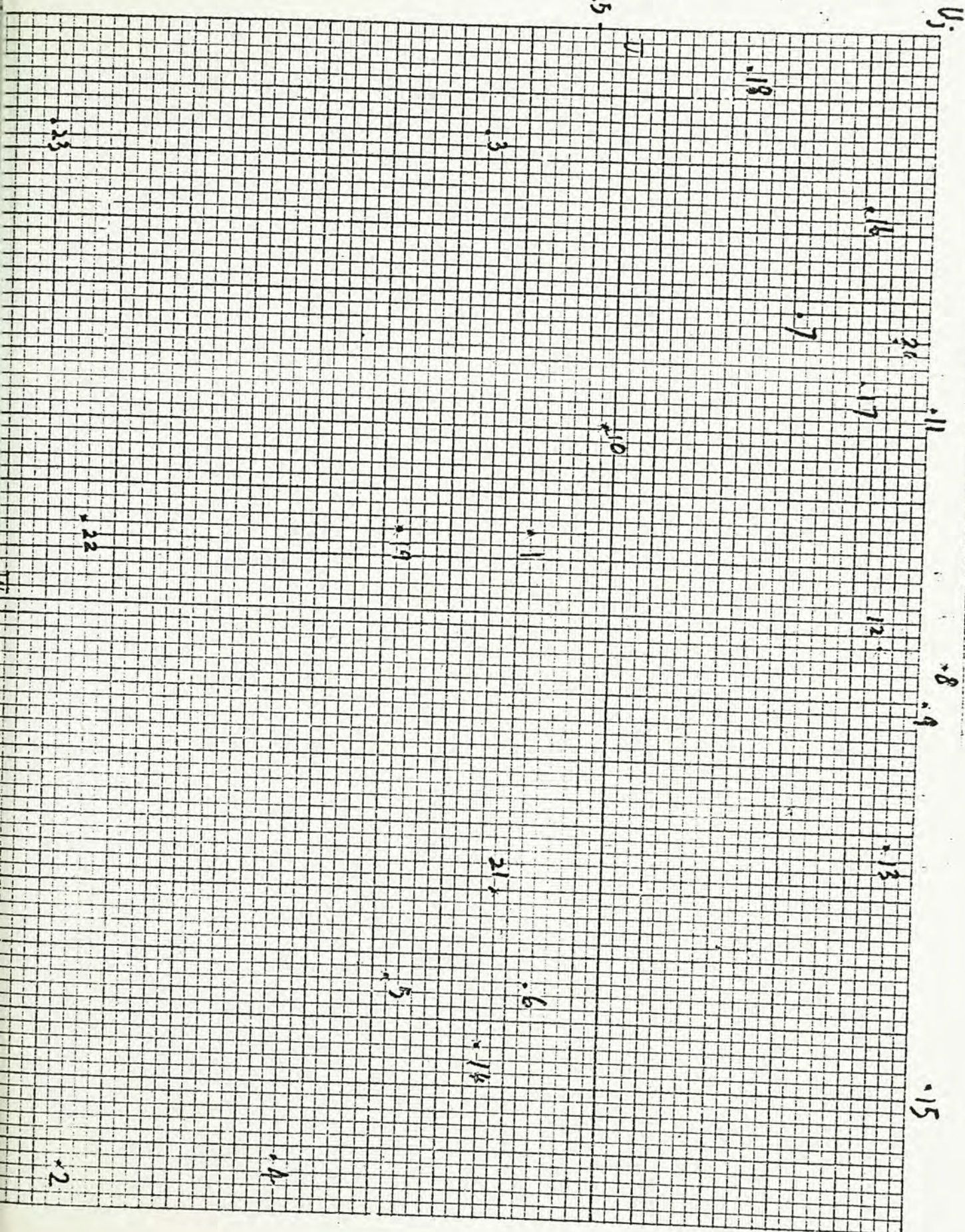
Graph III.3 Industries of Japan - 1970



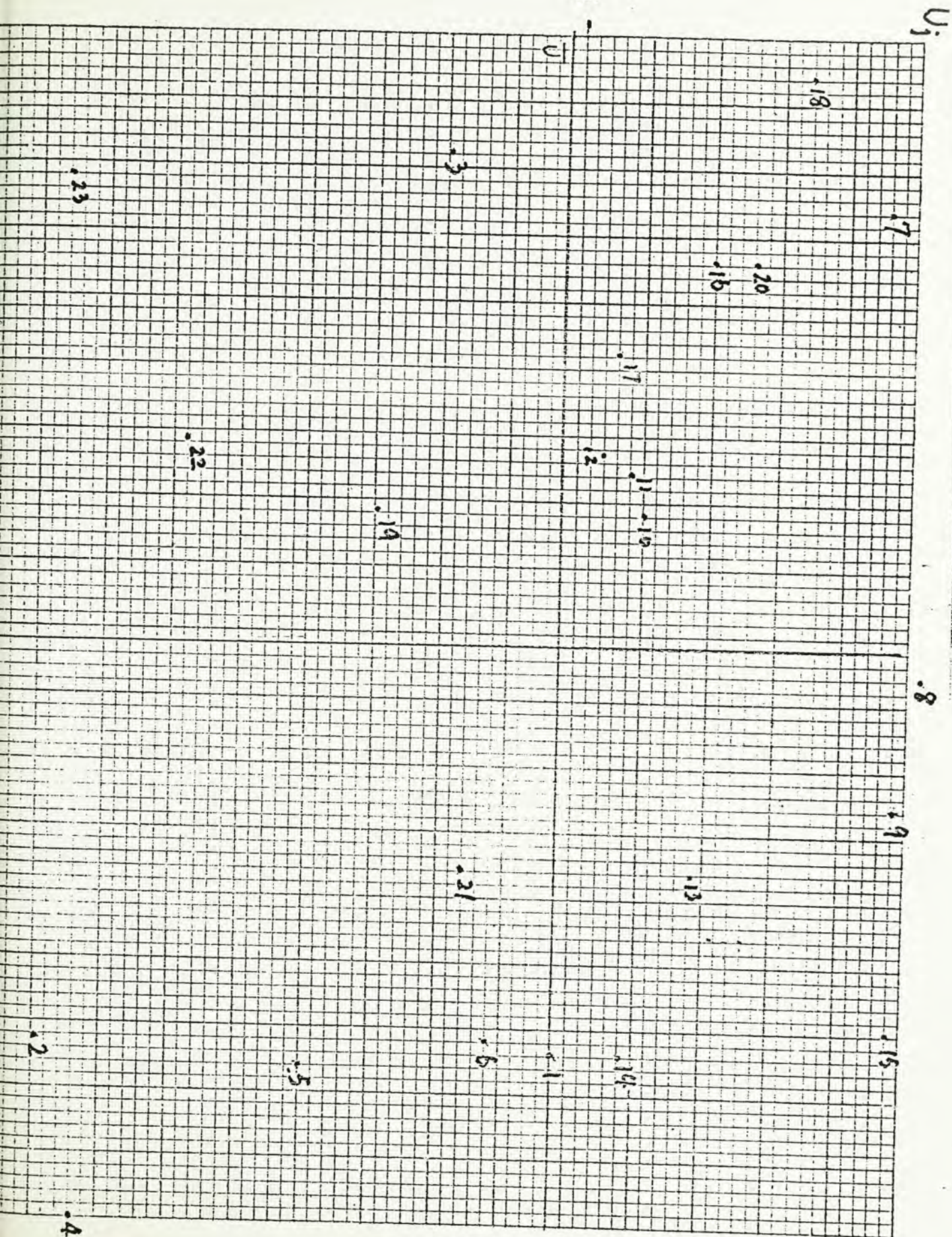
Graph III.4 Industries of Taiwan - 1966



Graph III.5 Industries of Taiwan 1969



Graph III.6 Industries of Taiwan - 1971



III.4 Import Dependence

Industrialisation in developing countries is often difficult and expensive to promote because of the large technological and scientific gap between the developed and developing countries. Developing countries are, therefore, under a handicap when they move into the industrial field. Time and expense are required to bring improvement and efficiency at production before industries in the developing countries can become competitive. It is an expensive process because lots of things have to be imported. Consequently, there will be high dependence on imports from the developed countries, even their industries are highly labour-intensive. Instead of reducing imports, the promotion of industry will generate further imports, at least in the earlier stages.

The main problem that arises from this situation is the inability of developing countries to pay for their imports. Both Japan and Taiwan are very much dependent on international trade. Basically, Taiwan is oriented towards exporting of manufactured goods and importing of raw materials and parts. Japan is much alike except that the commodities exported are heavy industrial products. Both countries lack natural resources, and thus carry the typical features of other underdeveloped countries.

In this section, we would investigate the import dependence of intermediate inputs in production rather than

the overall import dependence. This sort of investigation will, to a certain extent, be more fruitful for countries which are growing well (but not for those very primitive and underdeveloped ones). By and large, there are two tendencies existing in most developing countries : import-substitution growth and export-leading growth. Of course, these generally refer to final outputs. If an enormous amount of imported inputs are required during the process of production, the search for growth of the above two strategies, especially the former, will not be so fruitful.

For the consideration of the intermediate import dependence of Japan and Taiwan, we computed the imported input coefficients of the respective industries μ_j , and they are listed in Table III.3. Since $M_j = \mu_j X_j$, μ_j is the amount of imported input required for every unit of output. The overall μ_j for Taiwan is 0.12 in both 1966 and 1971. That of Japan is 0.07 in 1965 and 0.08 in 1970.

In Taiwan, as development proceeds, the demand for imported inputs has increased a little. On the whole, those heavy industries need more imported inputs : Petroleum need crude oil, Transportation Equipment, Machinery and Metal and Product need fuel, raw materials and parts. Most of the mentioned inputs are partly supplied or totally lacking locally. If we examine the situation from the point of view of variation between 1966 and 1971, the demand for imported inputs of the

Table III.5

Domestic Intermediate Input Coefficients and Imported Input
Coefficients of Industries of Japan

	1965		1970	
	$\sum_i d_{ij}$	μ_j	$\sum_i d_{ij}$	μ_j
1. Agriculture	0.32	0.01	0.35	0.01
2. Forestry	0.44	0.0011	0.47	0.0018
3. Fishery	0.28	0.02	0.26	0.01
4. Coal	0.45	0.18	0.40	0.39
5. Petroleum	0.09	0.39	0.12	0.37
6. Mining	0.35	0.01	0.33	0.01
7. Food	0.66	0.08	0.63	0.09
8. Textiles	0.66	0.09	0.66	0.07
9. Wood	0.67	0.07	0.61	0.11
10. Printing	0.50	0.01	0.51	0.01
11. Leather	0.52	0.25	0.59	0.22
12. Rubber	0.55	0.12	0.55	0.09
13. Chemicals	0.59	0.01	0.58	0.07
14. Non-metals	0.51	0.05	0.54	0.05
15. Metals	0.68	0.08	0.66	0.08
16. Machinery	0.59	0.02	0.62	0.02
17. Miscellaneous	0.62	0.03	0.62	0.03
18. Construction	0.62	0.01	0.61	0.01
19. Power	0.28	0.04	0.28	0.06
20. Communication & Transportation	0.26	0.04	0.25	0.05
21. Transportation Equipment	0.65	0.01	0.65	0.01
22. Trade	0.24	0.01	0.28	0.01
23. Services	0.21	0.0047	0.27	0.01

Table III.6

Domestic Intermediate Input Coefficients and Imported Input Coefficients of Industries of Taiwan

	<u>1966</u>		<u>1971</u>	
	$\sum_i d_{ij}$	μ_j	$\sum_i d_{ij}$	μ_j
Agriculture	0.40	0.01	0.47	0.02
Forestry	0.10	0.0004	0.10	0.01
Fishery	0.38	0.04	0.30	0.11
Coal	0.30	0.01	0.26	0.04
Petroleum	0.16	0.31	0.13	0.31
Mining	0.16	0.0034	0.12	0.01
Food	0.55	0.11	0.63	0.10
Textiles	0.53	0.25	0.58	0.17
Wood	0.60	0.16	0.56	0.18
Printing	0.66	0.02	0.49	0.05
Leather	0.45	0.18	0.41	0.12
Rubber	0.46	0.30	0.41	0.10
Non-metals	0.47	0.05	0.49	0.05
Chemicals	0.54	0.18	0.53	0.06
Metals	0.44	0.32	0.44	0.30
Machinery	0.46	0.26	0.31	0.29
Miscellaneous	0.57	0.14	0.38	0.15
Construction	0.60	0.0042	0.63	0.03
Communication &				
Transportation	0.29	0.12	0.25	0.10
Transportation				
Equipment	0.52	0.23	0.31	0.32
Power	0.45	0.0023	0.36	0.06
Trade	0.10	0.01	0.19	0.01
Services	0.11	0.01	0.11	0.01

Energy industry increased remarkably by 2380%. Other industries such as Forestry and Construction also increased considerably.

In Japan, the Energy and Petroleum industries are the most vulnerable ones in their dependence of foreign inputs. The percentage of imported inputs over total production for Petroleum was 39-37%. Coal was 19-39% and Leather 25-22%. However, from 1965 to 1970, the demand for imported inputs of the Petroleum industry dropped slightly. It is thought that the Japanese have long been striking for energy-saving technology. Their production of automobiles which can run more miles for each gallon of fuel was a good example. In this direction, the Japanese have really achieved some success as indicated by the decrease in the demand for imported inputs of the Petroleum industry.

In what follows we apply the absolute difference measure mentioned in the previous section to the imported input coefficients to find out to what extent the imported intermediate inputs of Taiwan and Japan are different. The method we employ will be similar to that in the previous section. We design an indicator which is denoted by c_j^{J-T}

$$c_j^{J-T} = \frac{|\mu_j^J - \mu_j^T|}{\frac{1}{2}(\mu_j^J + \mu_j^T)}$$

for this measurement.

Results at Table III.4 indicate that there is a major difference in the utilization of imported intermediate input between Taiwan and Japan. In 1965(66), the values of the absolute difference comparison of 9 industries (Mining, Coal, Printing and Publishing, Chemical, Metal, Machinery, Miscellaneous, Transportation Equipment and Power) exceeded 1.00, 5 of which (Coal, Chemical, Machinery, Transportation Equipment and Power) were even above 1.5. In 1970(71), 8 (Coal, Fishery, Printing and Publishing, Metal, Machinery, Miscellaneous, Construction and Transportation Equipment) exceeded 1.00, 4 of which were above 1.50. This drastic deviation is mainly due to the relatively high percentage of demand for imported inputs of Taiwan's industries. Results in Table III.3 can be used for such reference.

There is an obvious difference between three of their heavy industries, namely, Metal and Product, Machinery and Transportation Equipment. Also, the Miscellaneous Manufacturing industry, which consist mainly of electrical appliances, scientific apparatus and equipment is quite different between Japan and Taiwan. The value for Coal industry, which is above 1.7 , is a result of Japan's huge purchase in imported inputs.

There are two other sectors which merit attention. They are the Construction and Power industries. The former

Table III.7

Similarity in the use of imported intermediate inputs
(values of ϵ_i^{J-T}) between Japan and Taiwan

	<u>1965</u>	<u>1970</u>
Agriculture	0.14	0.72
Forestry	0.93	0.99
Fishery	0.53	1.60
Mining	1.17	0.77
Coal	1.72	1.61
Petroleum	0.23	0.16
Food	0.32	0.16
Textiles	0.95	0.90
Wood	0.83	0.46
Printing	1.16	1.56
Leather	0.29	0.56
Rubber	0.86	0.19
Chemicals	1.81	0.12
Non-metals	0.11	0.03
Metals	1.22	1.16
Machinery	1.67	1.75
Miscellaneous	1.37	1.39
Construction	0.27	1.21
Communication & Transportation	0.97	0.46
Transportation		
Equipment	1.83	1.88
Power	1.77	0.01
Trade	0.0000	0.30
Services	0.37	0.57

$$\epsilon_i^{J-T} = \frac{|\mu_i^J - \mu_i^T|}{\frac{1}{2} (\mu_i^J + \mu_i^T)}$$

develop from a comparatively similar imported input structure (value of $\xi^{J-T} = 0.30$) to a diverse one (value of $\xi^{J-T} = 1.2$), while reverse development take place for the latter (value of ξ^{J-T} change from 1.7 to 0.01). The development phenomena of these industries can be explained as an indication of Taiwan undergoing development. Construction includes both private and public construction. Taiwan was then advocating the construction of social infra-structure such as large scale irrigation, electrification of railways, highways, deep harbour, and also the export-manufacturing-industrial-zones. All these necessitate the in-flow of foreign technology, foreign capital, raw materials and intermediate inputs which Taiwan does not possess. This is in contrast to the past that the construction of Taiwan was comparatively simple, and the need for the import of inputs was low. Due to the relative rapid development in Taiwan in the recent years, the Construction industry imports large amounts of foreign supplies.

Our above analysis is based on the perception that the economy of Japan has advanced to the extent that it can self supply most of the intermediate inputs and technological knowhow required for the Construction industry.

On the other hand, the Power industry of Taiwan expanded and resulted in the increase of imported inputs (fuel and generators were possibly the major items), and in a higher degree of similarity of imported inputs structure to that of

Japan. Increase in fuel price was one of the factors, but certainly not an important one. It is because the increase in imported inputs for Power industry was rather stable in Japan during these five years (65-70) when the actual fuel crisis had not emerged.

This can be said to be another indication of the development of Taiwan. The amount of utilization of power can be a yardstick to measure the level of economic activities and in turn, the development stage of an economy.⁴²

The intermediate import structure for Japan was rather stable, except that of Chemicals industry which marked an increase of over 650%. The others were below 100%, some were even below 10%. In the case of Energy, there was a decrease in petroleum consumption, but other industries such as Chemicals industry, were not able to make less consumption possible. This, of course, is after all a weakness of Japan.

From the overall picture of the intermediate import structure of Taiwan whose average imported intermediate inputs were above 10% (mean values for 1966 and '71 were 11.9% and 11.4% respectively), we can see that Taiwan is much more dependent on foreign raw materials. Whereas Japan is, in comparison,

⁴² A strong positive correlation between per capital energy consumption and per capita share of GNP was reported by E.S. Mason and Sri Schurr in their Technology and Economic Development (Pelican 1965).

more self-sufficient in the period under review. Its average imported intermediate inputs are below 10% (mean values for 1965 and '70 were 6.6% and 7.6% respectively).

The imported inputs coefficients (μ_j) can shed light on the degree of import dependence. However, the total intermediate inputs can further be employed to weigh the degree of importance of the imported intermediate inputs. That is to say, even if the imported inputs of an industry appear to be small, if its total intermediate inputs is also small, then this industry is still dependent on imports. In what follows, our method is simply to weigh μ_j by $\sum_i a_{ij}$ for every industry, that is $\mu_j / \sum_i a_{ij}$. The results given in Tables III.8 and III.9 are on the whole consistent with our above analysis. In Japan, except for the energy industries, i.e. Coal and Petroleum industries, μ_j appears to be 30% and 49% of respectively. As for Taiwan, industries generally required more imported inputs, especially for those heavy industries like Petroleum (66.5-70.9%), Machinery (36-48%), Metal and Product (42-40%) and Transportation Equipment industry (30.6-51%).

Table III.8

Ratios of imported input coefficient of intermediate input
coefficient of industries of Japan

	<u>1965</u> $\mu_i / \sum a_{ij}$	<u>1970</u> $\mu'_i / \sum a'_{ij}$
Agriculture	0.03	0.03
Forestry	0.0025	0.0039
Fishery	0.07	0.04
Coal	0.29	0.49
Petroleum	0.82	0.76
Mining	0.04	0.02
Food	0.11	0.12
Textiles	0.12	0.09
Wood	0.09	0.15
Printing	0.01	0.01
Leather	0.32	0.30
Rubber	0.18	0.13
Chemicals	0.02	0.11
Non-metals	0.09	0.08
Metals	0.10	0.11
Machinery	0.04	0.03
Miscellaneous	0.04	0.04
Construction	0.01	0.01
Power	0.12	0.17
Communication & Transportation	0.14	0.18
Transportation		...
Equipment	0.02	0.01
Trade	0.05	0.04
Services	0.02	0.02

Table III.9

Ratios of imported input coefficient to intermediate input coefficient of industries of Taiwan

	$\frac{1966}{M_i / \sum a_{ij}}$	$\frac{1971}{M_i / \sum a_{ij}}$
Agriculture	0.03	0.04
Forestry	0.004	0.05
Fishery	0.09	0.26
Coal	0.04	0.14
Petroleum	0.67	0.71
Mining	0.02	0.10
Food	0.17	0.14
Textiles	0.32	0.23
Wood	0.21	0.24
Printing	0.03	0.10
Leather	0.29	0.23
Rubber	0.39	0.20
Non-metals	0.10	0.09
Chemicals	0.25	0.10
Metals	0.42	0.40
Machinery	0.36	0.48
Miscellaneous	0.19	0.28
Construction	0.01	0.05
Communication & Transportation	0.29	0.28
Transportation		
Equipment	0.31	0.51
Power	0.01	0.14
Trade	0.11	0.07
Services	0.06	0.10

III.4 Depreciation Structure

Although depreciation has been regarded as purely physical replacement of capital equipment, it is being looked upon as the rate of utilisation of new techniques embodied in new equipment. It is thought that the absorption of potential technological progress depends very much on the volume of replacement. In this respect, depreciation or replacement rate is important in economic growth and development.⁴³

The structure of depreciation should reflect the basic characteristics of an economy and acts as a device to control the degree to which the past can be coped with the present. Moreover, only economies with abundant capital accumulation can afford a high rate of depreciation while developing or underdeveloped countries with scarce capital accumulation is bound to accept a much lower rate of depreciation.

In the cases of Japan and Taiwan and with reference to Table III.5, we have the measurement δ_j as the rate of depreciation of the j th industry which is equal to depreciation value divided by its capital outlays.⁴⁴

The results of Table III.5 indicate that the depreciation rates of Taiwan's industries were lower than those of Japan

⁴³See, for example, E.D. Domar, "Depreciation, Replacement and Growth," Economic Journal, (March 1953) pp.1-32.

⁴⁴Although the general measurement of depreciation rate is the ratio of depreciation value to the respective capital stock value, as no capital stock data on an industry basis are available, the capital outlay on production would be an acceptable substitution.

during the years 1965(66) and '70(71) as we have expected. In both years the depreciation of Japan accounted for 27.8% and 23.3% of the capital shares while that of Taiwan was recorded to be only 19.1% in 1966 and 24.7% in 1971.

This signifies a tendency of development of Taiwan in the recent years. On one hand, some out-dated capital equipment are abandoned and some modern ones are adopted. On the other, the economy seems to have developed to a stage when higher depreciation rates can be afforded.

For further evidence on the above description, a similar calculation of the absolute difference measure in sections III.2 and III.3 is carried out in the following. The index for difference or similarity of the depreciation structure between industries of Japan and Taiwan is designed as the ratio of the absolute difference of depreciation of the same industry in both countries to the respective mean value.

$$\xi_j^{J-T} = \frac{|\delta_j^J - \delta_j^T|}{\frac{1}{2}(\delta_j^J + \delta_j^T)}$$

According to Table III.6 where the results are presented in 1965(66) there were five industries (Forestry, Mining, Leather, Construction and Power) with ξ_j^{J-T} whose values were larger than 1.00. But later in 1970(71), there was no industry with a ξ_j^{J-T} value larger than 1.00. It

seems that each individual industry of Taiwan displays a similar pattern to every industry of Japan. This phenomenon well supports our former analysis.

However, a word should be noted is that, the measure of depreciation in this section is heavily based on the Input-Output statistics as previously mentioned. These statistics may be originated from some census of industries. The item depreciation in the tables would be some accounting entries which are overstated for tax-relief purpose instead of real capital displacement measures.

Table III.10

Rate of Depreciation

$$D_j / Q_j K_{jj} = \delta_j$$

	<u>Taiwan</u>		<u>Japan</u>	
	δ_j		δ_j	
	<u>1966</u>	<u>1971</u>	<u>1965</u>	<u>1970</u>
Agriculture	0.07	0.20	0.12	0.15
Forestry	0.02	0.14	0.10	0.11
Fishery	0.19	0.21	0.26	0.29
Coal	0.26	0.57	0.42	0.39
Petroleum	0.09	0.22	0.24	0.21
Mining	0.09	0.16	0.45	0.47
Food	0.44	0.22	0.19	0.21
Textiles	0.26	0.34	0.29	0.33
Wood	0.18	0.23	0.36	0.27
Printing	0.15	0.19	0.12	0.14
Leather	0.04	0.26	0.26	0.15
Rubber	0.27	0.28	0.25	0.42
Non-metals	0.20	0.34	0.38	0.34
Metals	0.10	0.21	0.30	0.30
Chemicals	0.27	0.27	0.28	0.27
Machinery	0.15	0.33	0.20	0.20
Miscellaneous	0.14	0.12	0.27	0.29
Construction	0.69	0.28	0.15	0.22
Communication &				
Transportation	0.42	0.41	0.52	0.48
Transportation				
Equipment	0.12	0.18	0.61	0.59
Power	0.07	0.27	0.34	0.33
Trade	0.04	0.13	0.10	0.12
Services	0.13	0.12	0.11	0.22

Table III.11

Similarity in Depreciation Structure between Japan and Taiwan

(Values of \sum_j^{J-T})

	<u>1965</u>	<u>1970</u>
Agriculture	0.53	0.33
Forestry	1.29	0.26
Fishery	0.29	0.34
Mining	1.30	0.98
Coal	0.46	0.36
Petroleum	0.93	0.03
Food	0.17	0.07
Textiles	0.10	0.03
Wood	0.63	0.16
Printing	0.24	0.33
Leather	1.41	0.53
Rubber	0.06	0.38
Chemicals	0.35	0.25
Non-metals	0.40	0.10
Metals	0.92	0.25
Machinery	0.27	0.48
Miscellaneous	0.63	0.83
Construction	1.27	0.24
Communication &		
Transportation	0.36	0.35
Transportation		
Equipment	0.99	0.58
Power	1.56	0.55
Trade	0.99	0.0040
Services	0.21	0.59

$$\sum_i^{J-T} = \frac{|\delta_i^J - \delta_i^T|}{\frac{1}{2}(\delta_i^J + \delta_i^T)}$$

Chapter IV

The General Production Structures

IV.1 Introduction

In this chapter, we attempt to study the general production structures of Japan and Taiwan in terms of the Cobb-Douglas production function. Production functions have been widely discussed in developed countries. However, only relatively limited research has been done on developing or less developed countries such as Taiwan. The reason for this is either due to the scarce availability of statistics or some worries on the problem of perfect competitiveness of the markets. In earlier days, it is very likely that these problems exist in Taiwan as well as in other underdeveloped areas where unemployment or underemployment were very prevalent. Yet, in the period of 1964-1971 under discussion, the situation of serious unemployment no longer existed in Taiwan, not to mention that of Japan. However, collection of data is still difficult for Taiwan. Up to present, not one good industrial census has been established which reveals well the production relationship of outputs and inputs.

As we have noted in Chapter 2, the "labour" input we have used for regression purpose are in fact wage bills in the Input-Output tables. They constitute different wages for different types of labour with different skills, occupations and ranks. Altogether, they represent some weighted labour inputs in which quality has been implied but concealed.

Under the term "capital", which in most cases cannot be shown in physical value, we are not an exception to have them in value terms. We have added up many items - other incomes (which include interests, rents, transfers and profits) depreciations and taxes (which is some sort of profits or working funds of firms and industries)⁴⁵ - to arrive at the capital value. The capital in this context refers to capital flows rather than capital stock values. The output values we have taken are value added figures instead of gross production values which also include the intermediate inputs.⁴⁶ We have tried two sets of output data for the estimation, the value added data and the gross production data, and found that the former gives better regression results.

Rewriting Equation (1)

$$\ln PX = \ln A^* + \alpha^* \ln (wL) + \beta^* \ln (rK)$$

and taking derivatives with respect to labour outlay (wL) for both sides, we have

$$\begin{aligned} \frac{\partial(PX)}{\partial(wL)} &= A^* \alpha^* (wL)^{\alpha^*-1} (rK)^{\beta^*} \\ &= \alpha^* \frac{PX}{wL} \end{aligned}$$

$$\alpha^* = \frac{wL}{PX} \frac{\partial(PX)}{\partial(wL)}$$

$$\text{and similarly } \beta^* = \frac{rK}{PX} \frac{\partial(PX)}{\partial(wL)}$$

⁴⁵ Although the nomenclature of the items differ slightly in the Input-Output tables of Japan and Taiwan, the meaning are actually the same.

⁴⁶ In the final section of this chapter, we again employ the gross production value for regression to show the significance of intermediate inputs in the production process.

The exponents α^* and β^* measure the elasticities of output values with respect to the outlays on labour and capital respectively.

If we take the derivative for both sides with respect to labour, keeping product price constant, we have

$$PX = A^* (wL)^{\alpha^*} (rK)^{\beta^*}$$

$$P \frac{\partial X}{\partial L} = A^* \alpha^* (wL)^{\alpha^*-1} (rK)^{\beta^*} \frac{\partial (wL)}{\partial L}$$

then

$$\alpha^* = \frac{\frac{\partial X}{\partial L}}{\frac{X}{wL} \left(w + L \frac{\partial w}{\partial L} \right)}$$

$$= \frac{\frac{\partial X}{\partial L}}{\frac{X}{L} \left(1 + \frac{L}{w} \frac{\partial w}{\partial L} \right)}$$

$$= \frac{\frac{\partial X}{\partial L}}{\frac{X}{L} (1 + e_L)}$$

and by the same token

$$\beta^* = \frac{\frac{\partial X}{\partial K}}{\frac{X}{rK} (1 + e_K)}$$

the e_L and e_K in this context are some "elasticity of change of wage rate with respect to change of labour" and "elasticity of change of capital."⁴⁷ They represent the slope of the "locus" of all equilibrium points resulted from supply interacting with demand. These two elasticities would be either positive, negative or zero depending on the market structure and in turn on demand and supply interactions.⁴⁸

If $e_i = 0$ for $i = L, K$, then $\alpha = \alpha^*$, $\beta = \beta^*$ i.e. the parameters obtained from our estimation which utilizes monetary values of inputs and outputs would exactly equal those obtained from estimation with purely physical measures.

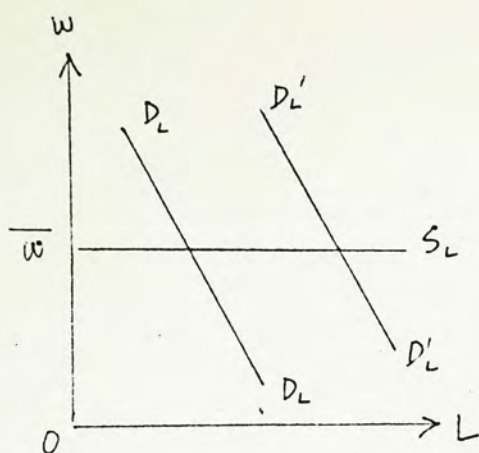
In the short run, if we assume the labour wage rate to be fixed and thus the fluctuation of demand for labour will not give rise to any changes of wage rate. This means the elasticity e_L will have a zero value if the period under consideration is short enough. But if the problem is a long run one, there will be no definite answer since we do not know much about the interaction of labour supply and demand.

⁴⁷Please refer to and compare with the results in Chapter 2.

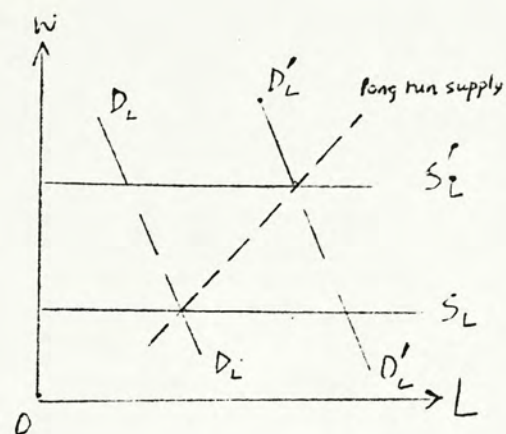
⁴⁸ e_L or e_K can be obtained by regressing $\ln w$ with $\ln L$ and $\ln r$ with $\ln K$ respectively provided that their data are available.

$$\ln w = e_L \ln L + u$$

$$\ln r = e_K \ln K + u$$



short run condition



long run condition

Since our estimations are made on a cross-section basis and will be considered to be very short-run cases only, the estimated parameters (especially the output elasticity with respect to labour) will be very close to those estimates from purely physical measures. Certainly, we know very little about the capital market, the elasticity ϵ_k is still indeterminate and creates difficulties in the interpretation of the capital exponents β^* .

IV.2 The findings of α^* / β^*

The data of Japan and Taiwan fitted quite well to Equation (1). The results are shown in Table IV.1. Statistically, all the estimates give satisfactory measures. The coefficients of determination are all above 0.9 and estimated parameters are all significant at the 5% level.

The ratio of labour coefficient to capital coefficient i.e. α^* / β^* lies on the range of about 0.44 and 0.94 respectively in Japan and Taiwan. Those of Japan seem to be relatively stable through time while those of Taiwan vary considerably. In Japan the capital coefficients of respective years (1960, 1965 and 1970) are much greater than the labour coefficients. More expense on capital gives greater output but more expense on labour will be less fruitful. This signifies the situation in Japan. Although our estimates are based on an indirect method, they still conform to the usual expectation that industries of Japan are capital-intensive. Since the Meiji Restoration, industries of Japan have been pursuing towards this end with the encouragement from the Government. This is especially true for the industry of Machinery and Transportation Equipment. This is why most scholars believe the industrialisation of Japan is supply-oriented and not demand-oriented.⁴⁹

⁴⁹H.B. Chenery, S. Shishdo and T. Watanabe, "The Pattern of Japanese Growth, 1914-1954," Econometrica, Vol.30 (Jan. 1962) pp.98-137.

Table IV.1
Results of Estimations of Production Functions of Japan and Taiwan

Japan

	<u>Constant</u>	<u>Labour</u>	<u>Capital</u>	<u>$\alpha^* + \beta^*$</u>	<u>R^2</u>
	A*	α^*	β^*		
1960	0.65	0.29 (13.79)	0.71 (34.20)	1.00	0.99
1965	0.55	0.33 (18.09)	0.68 (34.74)	1.01	0.99
1970	0.69	0.30 (14.96)	0.71 (36.98)	1.01	0.99

	<u>Constant</u>	<u>Labour</u>	<u>Capital</u>	<u>Domestic Intermediate Inputs</u>	<u>Imported Intermediate Inputs</u>	<u>Sum of Exponents</u>	<u>R^2</u>
	A*	α^*	β^*				
1970	1.71	0.08 (2.27)	0.34 (13.23)	0.46 (13.62)	0.09 (6.55)	0.98	0.99
1965	1.62	0.10 (2.51)	0.32 (9.70)	0.47 (13.12)	0.08 (5.70)	0.98	0.99

(In brackets are t values of estimated coefficients)

Table IV.1 cont.

Taiwan

	<u>Constant</u>	<u>Labour</u>	<u>Capital</u>	<u>$\alpha^* + \beta^*$</u>	<u>R^2</u>
	A*	α^*	β^*		
1964 1964	0.87	0.59 (6.81)	0.40 (3.69)	0.99	0.98
1966 1966	0.16	0.48 (7.14)	0.57 (4.85)	1.05	0.97
1969 1969	0.49	0.45 (8.56)	0.58 (6.62)	1.03	0.96
1971 1971	0.30	0.41 (7.11)	0.63 (7.03)	1.04	0.98

	<u>Constant</u>	<u>Labour</u>	<u>Capital</u>	<u>Domestic Intermediate Inputs</u>	<u>Imported Intermediate Inputs</u>	<u>Sum of Exponents</u>	<u>R^2</u>
	A*	α^*	β^*				
1964 1964	1.70	0.22 (4.11)	0.23 (7.42)	0.50 (10.59)	0.03 (2.85)	0.98	0.98
1966 1966	1.85	0.18 (4.26)	0.25 (6.80)	0.49 (10.72)	0.04 (2.78)	0.97	0.96
1969 1969	2.18	0.13 (3.55)	0.28 (8.43)	0.48 (11.74)	0.05 (3.72)	0.95	0.96
1971 1971	1.49	0.17 (4.00)	0.30 (8.05)	0.47 (12.35)	0.06 (3.37)	1.00	0.96

(In brackets are t values of estimated coefficients)

All along, the labour of Japan is more expensive than its capital (especially on comparison with other underdeveloped countries). This urges the industries of Japan to use relatively more capital and less labour.

With respect to the situation in Taiwan, our results show that the ratio of labour coefficient to capital coefficient α^*/β^* is 0.94. The increase in output brought about by an increase in labour outlay or by an increase in capital outlay is also the same. Or put it in another way, half of the increase in product is distributed to capital inputs and the other half to the labour inputs.⁵⁰

⁵⁰ This results resemble that of Murti and Sastry. Their research on Indian industries shows that :

	<u>Constant</u>	<u>α</u>	<u>β</u>	<u>R²</u>
1951	1.03	0.59	0.40	0.98
1952	0.68	0.53	0.50	0.95

Another study on production function of developing area is that of Hong Kong by Edward Chan in his "Economies of Scale and Capital-Labour Substitution in Hong Kong Manufacturing," in the Hong Kong Economic Papers (April 1977). The results of the study by Chan are :

	<u>Constant</u>	<u>α</u>	<u>β</u>	<u>R²</u>
1973	5.629	0.49	0.43	0.837

Further examination of the changes during these few years indicates that the coefficients of Japan remain very stable. The labour coefficient in 1965 is slightly larger than that in '60 and '70. This may be due to some fluctuation in prices. But for Taiwan, the labour coefficients reduced from 0.59 in 1964 to 0.48 in 1966 and from 0.45 in 1969 to 0.41 in 1971, while the capital coefficients changed in the opposite direction. These changes are not insignificant and seem to follow a pattern.

This is an interesting finding. In most countries, especially the advanced ones, there are little changes in these parameters. Only within a long duration will there be significant variations. The labour and capital coefficients normally remain constant for decades.

Since the whole estimation is based on an aggregative and indirect method, the underlying meaning of the so obtained coefficients is very complicated and it is not easy to be interpreted.

If we recall that the estimated coefficients corresponding to capital and labour are given by

$$\alpha^* = \alpha \frac{1}{1 + e_L} \quad \beta^* = \beta \frac{1}{1 + e_K}$$

If during the period of estimation, e_L and e_K are constant, the sign for $\frac{d\alpha^*}{dt}$ and $\frac{d\beta^*}{dt}$ should be the same.

That is to say, the over time changes of our estimated coefficients α^* and β^* under the assumption of no changes of ℓ_L and ℓ_K , especially if wage rate is kept rigid, can at least reflect the change of the ordinary output elasticities α and β .

Our estimations set no restriction on the sum of the parameters ($\alpha^* + \beta^*$). We find that ($\alpha^* + \beta^*$) values are all slightly greater than 1. However, this result does not imply "constant return to scale" of productions within the two economies under study. It tells us that the aggregate cross-industry estimation only represents some sort of average or just an overall structure of the industries. By and large cross-section (cross-industry or cross-firm) studies at the aggregate level can tell very little about the economies of scale. We should say if a large industry uses an amount of inputs which is twice as much as that for a little industry, and produces an amount of output which is more than twice of the little one, then this is evidently a sign of large scale production. But we could easily understand that this hinges heavily on the classification of industries. If the said larger industry has been split into several equal parts by applying some finer classification, then the result will be just the reverse. The smaller industries seem to be more productive than the larger ones. This would give a picture of diseconomies of scale.

The explanation of constant return to scale under cross section studies may lie in the fact that there is an automatic mechanism to direct the flow of higher productive inputs into those industries of higher reward. Further, there is no causal relation that productivity breakthrough should occur in a particular size of industry. If demand condition or technology changes, the changes may occur in large as well as in small industries. After the statistical averaging process, constant return may still prevail.

Lastly, the fitting of cross-section data into the production function as in our research is an ex-post analysis of the production. Output sales revenue has been fully distributed among capital and labour inputs. The estimated parameters are then bound to be summed up to unity.

IV.3 Technological State

Technological progress is so important for every economy that it accounted for a major source of the increase in production output. Based on the results obtained we try to give some notes on this aspect accordingly. However, our studies of production function has given rise to some ambiguous results regarding the technological state of Taiwan. The estimated "intercepts" of the production function of Taiwan show a staggering downward trend which was very the case in other studies on production functions. The changes undulate wildly. In particular, the variation between 1964 and 1966 even reaches a level of 80%. Results of the estimated technological residual A^* for Japan seem to be more stable. They are 1.91, 1.73 and 1.99 for the years 1960, 1965 and 1970 respectively.

The results obtained can tell very little about the real technological state and its progress since data employed in the estimation of them are in monetary terms. However, they do give some views on the production structures which heavily embody the market situations.

Recall the following equation :

$$PX = A^* (wL)^{\alpha^*} (rK)^{\beta^*}$$

where

$$A^* = \frac{A^{\eta_L} b_x}{b_L^{\alpha \frac{\eta_L}{\eta_L}} b_K^{\beta \frac{\eta_K}{\eta_K}}}$$

we can easily find that the residual term under our estimation is quite different from that of the ordinary estimation. The term A^* is equal to A multiplied by some elasticities of product and inputs. However, if all the elasticities remain constant overtime, comparison of A^* between two years can still reflect the change of A .⁵¹

⁵¹ With Equation (1) we can find that the change of A^* goes along with some changes of prices of output and inputs. Taking the time derivatives of its log form,

$$\frac{\dot{P}}{P} + \frac{\dot{X}}{X} = \frac{\dot{A}^*}{A^*} + \alpha^* \frac{\dot{L}}{L} + \beta^* \frac{\dot{K}}{K} + \alpha^* \frac{\dot{w}}{w} + \beta^* \frac{\dot{r}}{r}$$

and compare it with the Solow's proposition

$$\frac{\dot{X}}{X} = \frac{\dot{A}}{A} + \alpha \frac{\dot{L}}{L} + \beta \frac{\dot{K}}{K}$$

performing subtraction with the two equations with the assumption that $\alpha^* = \alpha$, $\beta^* = \beta$, we have

$$\frac{\dot{P}}{P} = \frac{\dot{A}^*}{A^*} - \frac{\dot{A}}{A} + \alpha \frac{\dot{w}}{w} + \beta \frac{\dot{r}}{r}$$

or

$$\frac{\dot{A}^*}{A^*} = \frac{\dot{A}}{A} + \frac{\dot{P}}{P} - \left(\alpha \frac{\dot{w}}{w} + \beta \frac{\dot{r}}{r} \right)$$

The difference between \dot{A}^*/A^* and \dot{A}/A will be entirely due to some changes in prices of output and inputs.

If $\dot{A}/A = 0$ or $A = \text{constant}$, then $\dot{A}^*/A^* \geq 0$ provided

$$\frac{\dot{P}}{P} - \left(\alpha \frac{\dot{w}}{w} + \beta \frac{\dot{r}}{r} \right) \geq 0$$

Generally speaking, the sources of technological progress are rooted in those exporting industries and those industries with foreign investment. In international market the exporting industries have to compete to survive and in this competing process achieve their progress while the ones with foreign investment injected intending to exploit the cheap labour always bring with it foreign technology which certainly has some influence on the local industries of Taiwan. However, the facts may not be so simple. In the respect of exporting industries of Taiwan, local cheap labour render them advantage in that competition becomes less keen for them in the external market. What is more the Government has always bred the exporting industries with subsidy and further offset their inclination towards competition.

The foreign-invested industries have very little impact on the local industries. On one hand the local industries may find themselves technologically too far away from the foreign-invested ones, on the other hand the foreign-invested industries may not favour the leakage of their production secrets and very often they import intermediate parts and material from their mother countries. As Prof. M.H. Hsing pointed out, most Taiwan firms still maintain and operate in the conservative ways. Factories that employ workers of under 100 represent 99.2% of the total in 1961. These small

factories employ a total of 61.2% of the labour force while their equipped horsepower is only 27.4% of total horsepower used in the industrial sector. Five years later, factories which employ more than 100 people still represent less than 3% of the total. Although firms which have a larger scale of production have increased their employment of labour from 38.8% to 57.3% of the total, their equipped horse power only increased by less than 3% (from 72.6% to 75% of total). Their equipped horse power relative to labour employed was drastically decreased.

IV.4 Above-average Industries

After considering the production structures of the manufacturing sector as a whole, we hope to proceed further to study the performance of individual industries. However, the limited statistics available make this attempt difficult. We, therefore, could only use the simplest method to try to evaluate those industries showing better performance i.e. the above-average industries.

We try to plug estimated coefficients i.e. α^* , β^* and A^* into the original data in order to see which industries will give higher or lower output if they had employed the average production parameters.

These production parameters represent an average production structure which consists of many elements, technology, productivities, allocation of inputs and distribution of rewards, economies of scale in our context, the underlying market structure (especially the input market structure).

During this "plugging in" process, we will discover that the outputs of some of the industries are larger than their actual value, and for some are smaller. This indicates that the production performance of the former is worse, while that of the latter is better. We may, therefore, say that the former industries are "below average," and the latter are "above average."

Very interestingly, we find that industries of Taiwan which belong to the latter group are those primitive industries. They are the food manufacturing industry, the mining industry and the public utilities industry (i.e. electricity and water supply). However, those of Machinery, Electrical Product, Chemistry and Metal Product industry experience increase in output values. We find that food, mining and public utilities industries are above average in Taiwan while a major portion of the manufacturing sector (industrial sector) are below average. This is quite a conspicuous finding. In most cases, we would expect that those machinery and electrical industries and so forth should have acquired better technology. Also their scale of production is relatively larger. Some of them are exporting goods and have protection from the Government. This results indicate discrepancy in our expectation.

As for Japan, we use the same method of "plugging in" the estimated parameters. However, we cannot find any specific pattern of the above- or below-average industries. This indicates that every industry of Japan has its own line of development and up to certain level of maturity. The ups and downs may just be incidental. They may be the result of individual performance or market fluctuations which have little to do with technology of production.

IV.5 Further Results on the Estimation of Production Structures

As we have mentioned in Chapter 3 intermediate inputs are important to the industries of Taiwan and Japan. In this section, we attempt to extend the preliminary result by putting the intermediate inputs as a variable in the production function. We have

$$X = AL^{\alpha} K^{\beta} I^{\gamma}$$

where I stands for intermediate input and γ is the output elasticity with respect to it.

Actually, intermediate inputs should not be included in a production function like this, since the intermediate inputs of any industry are in fact the outputs of another industry (or industries). Therefore, they are double counted. Now, if gross production values instead of value added values are used to measure the output, the above formula may well be an average structure for further reference. Also this should be a way to find out the role of intermediate inputs in the production process.

The formula will be clearer if we further divide the intermediate inputs into domestic inputs and imported inputs. Imported inputs are factors outside the system, and may well be treated as individual inputs which are different from the double counted domestic inputs. The results are shown in Table IV.1.

Data of both Japan and Taiwan give satisfactory result. We find that intermediate inputs do carry a heavy weight in the contribution to output. However, this tells us very little about the role of the intermediate inputs because of their double-counted nature. They are not something outside of the production process, but are produced by the same group of labour and capital equipment.⁵³

Imported intermediate inputs are quite different. They can be treated as another kind of inputs just as labour or capital. They are not produced by the own resources of the economy but are derived from the rest of the world.

The result tells us that in both Japan and Taiwan, imported inputs are quite important in the process of production. Imported inputs have a very heavy weight. In Taiwan, the output elasticities with respect to imported intermediate inputs are 0.05 and 0.06 in 1969 and 1971 respectively. In Japan, the elasticities with respect to imported intermediate inputs are 0.08 and 0.09 in 1965 and 1970 respectively.

During these few years under study, the magnitude of the elasticity with respect to imported intermediate inputs continues to increase every year. The change in magnitude is great, viz. from 0.026 in 1964 to 0.064 in 1971. The

⁵³ Some of the intermediate inputs may come from the agriculture and service industries and therefore, not produced by the same labour and capital.

average increase is about 36% annually. This is a good evidence which shows the import dependency of Taiwan in terms of intermediate linkage in the course of production.

Chapter V

Conclusion

Certainly no one will suggest that there are two countries which are completely similar in their approach to development. However, it may be possible to discover some sort of hints in the uniqueness of each nation's experience in the course of modernization. Even though Taiwan had been under the domination of Japan for many years, there are not many similarities between Japan and Taiwan. The major reason is that during Japan's reign, emphasis and efforts had only been put on agriculture, and not on industries. This, however, had become advantageous to Taiwan in that Taiwan had a better agricultural base to fight its way to industrialize. Today, Taiwan is a developing country, developing into a "Dualistic Economy".

In previous chapters, the analysis of the Input-Output structures of Japan and Taiwan presents a picture showing considerable differences between the two countries as far as production is concerned. First of all, the use of indirect inputs instead of direct labour or capital in the course of production is more popular in Japan than in Taiwan viewing from either the supply or the demand perspective. This is shown by the different U_j values and W_i values of the two countries. Furthermore, from several graphs we have evidence that Japan has comparatively more industries which can lead to promote economic development. These industries all have relatively large linkage effects, both forward and backward.

In Chapter 3, the four categories analysis discernably tells us that a large part of the economy of Japan has moved to the Intermediate-Manufacture production. For Taiwan, however, very few industries belong to this group.⁵⁴ On the other hand, there are comparatively more industries of Taiwan which belong to Area I. These industries all have substantial backward linkage effect. This, of course, can also lead in economic development. We must, however, never forget that this backward linkage effect has a great possibility of shifting to foreign countries. In the early stages of development, when the supplying industries had not been well-founded or had even been non-existent, demand for inputs would very often direct towards foreign sources. To establish a good supporting base for industrialisation, such as attaining agricultural sufficiency, building of power supplies stations and the construction of other social infrastructure, is therefore much urgent than any other economic policy. This point has been noted in many economic literature as actual facts in developing countries. This, of course, should be regarded as a reference for many developing countries. For developing countries, developing industries with forward linkage effect seems to be more important than developing those with backward linkage.

⁵⁴ If our classification is in more detail, the picture is certainly clearer.

By and large, the structure of production of Japan experiences no serious changes over time. Almost all the parameters under study remain quite stable during the ten years from 1960-1970. However, the situation in Taiwan fluctuates a little.

Japan, after many years of modernisation, seems to have attained a path of steady growth. There is no need to change its structure of production. Taiwan, seeking its way out of poverty, tries to adjust itself in the hope of paving the most optimal path for development. Taiwan is undergoing a period of transition. It is much more justified to be regarded as "developing" rather than as "underdeveloped".

If we recall the discussion on the utilisation of indirect inputs (parameters U_j and W_j), the circulation of capital goods as the rate of depreciation (parameter δ_j) and the dependence on imports inputs (parameter μ_j) in Chapter 3 and the estimation of labour and capital coefficients (parameters α^* and β^*) of a remodelled Cobb-Douglas production function in Chapter 4, we can see that all these parameters for the economy of Taiwan change staggeringly over time.

Among all the changes, a point can be noted which is very much different between Japan and Taiwan. The residual parameter for technological state for Taiwan declines over

time while that for Japan remains quite stable. Although the parameter A^* in our estimation cannot fully reflect pure technological status, the finding is still in congruence with the actual condition of Taiwan. Prof. Hsing explains, with his fluent knowledge of the situation, that the problem lies in the fact that the organisation of individual firms or factories is still backward and traditional, and the equipped capital facilities relative to the manpower has even decreased during the recent years. Our estimation on the residual parameter further enhances his explanation.

Although Japan and Taiwan differs in their production structure and Japan is, by any measure, more advanced than Taiwan in the course of economic development, they resemble each other in their dependence on imports. Both countries are lacking in resources, just like many other less developed countries.

Our findings show that the imports of intermediate goods in Taiwan and Japan have increased over time. In another words, as development proceeds, the requirement of imported materials and equipment also increases. Therefore, the insufficiency of the factor endowment always forms the obstacle to economic development. Although Japan has overcome the obstacle, the lack of resources is still a burden to its further growth. On one hand, the only way to exchange for imports is to increase exports. On the other, it is also essential to increase the trading power in the international market. To increase the trading power will involve many other economic elements which are beyond the scope of this thesis.

It has long been debated which strategy is more appropriate for the development of an underdeveloped country, Nurske's balanced growth or the unbalanced growth as proposed by Hirschman. The concept of a leading industry sheds some light on this issue. Owing to the scarcity in resources, the shortage of entrepreneurial skill, the inadequacy of infrastructure and the immaturity of markets, an underdeveloped country is rarely possible to pursue the development policy in all fronts at the same time. Furthermore, the deficiency in demand is another possible barrier that a less developed country has to overcome. A more selected approach with the leading sectors at the core would ensure that demands are induced.

The importance of the leading industries has been explained in Chapter 3 in which we try to identify the industries of Japan and Taiwan which lead the respective economy to further growth. The category II industries in both countries bear the strongest forward and backward linkage effects and they worth the major attention for development strategy. In Japan they ^{are} as follow : Textiles, Leather, Wood, Metal, Coal, Rubber, Chemicals, Non-metals and Publishing industries, while in Taiwan they are as follow : Textiles, Wood, Metals, Chemicals and Non-metals industries. These industries in both countries respectively serve to create effective demand for products from other industries; open possibilities for further ^{growth} of other sectors on the one hand, and to supply low cost inputs to them as substitutions for imported inputs on the other.

There has been a tendency to treat Agriculture as somewhat backward, a sector incapable of providing the momentum for rapid development of an economy. However, Agriculture has been the leading sector to growth in many countries with its supplies absorbed by other industries it often proves to be the origin of the development impetus.

In our study, the Agriculture industry in Taiwan moved from the Primary-Final category into the Primary-Intermediate category. The role of the Agriculture sector becomes much more important in the development process as it no longer produces solely for final consumption but produces for further production in other industries such as the food manufacturing industry. Due to its new role, the Agriculture industry should be given more attention and worth more encouragement from the Government.

The idea of a leading industry is useful in helping to understand the pattern of development. As an economy develops, the leading industry pays for the imports required by other sectors and through its linkages promotes the emergence of new sectors. As a country develops over time, it gradually diversifies and the individual industry will become less dominant. However, the momentum for the early stages provided by the leading ones is essential.

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